Data for Paper Published 1971
LACM Contrib Sci #217

See Also

Mancalla measurements
folder which includes
M. cedrosensis Tables

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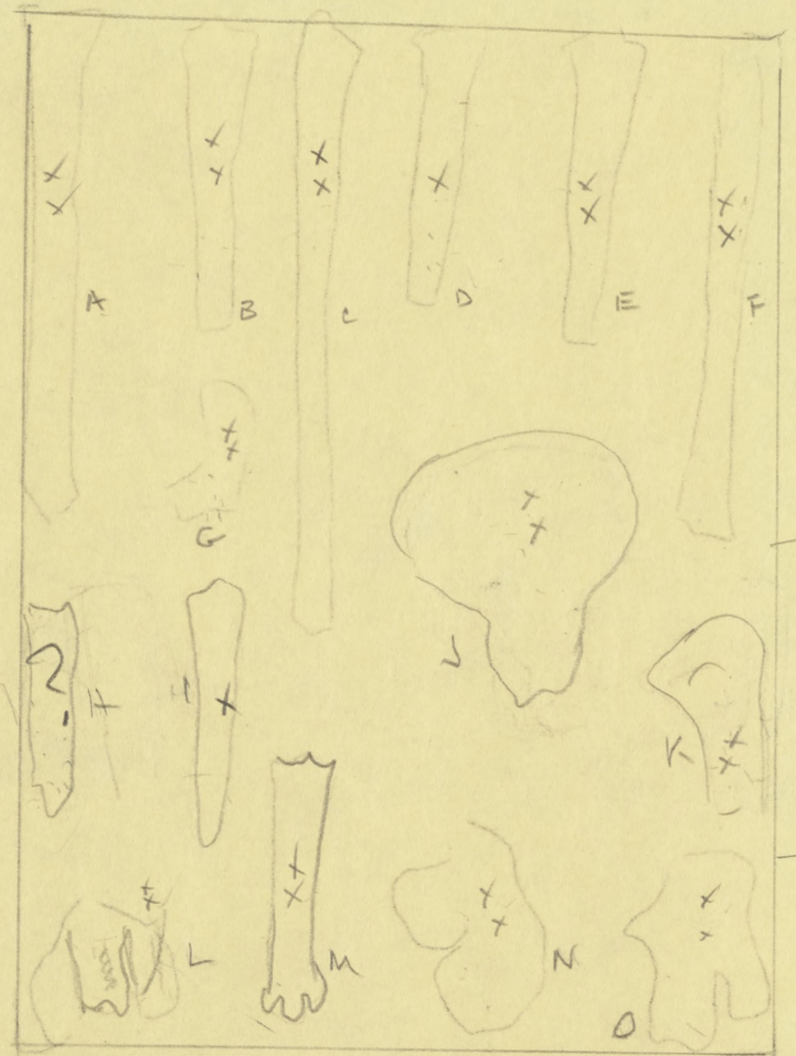

Plate 1. A + F Type tarsometatarsus Puffinus tedfordi anterior + posterior views; B and E P. tedfordi paratype tarsometatarsus; C. Puffinus sp. ulna 15403 —— view; G, H, I and K Cerorhinca minor, G coracoid 15421; H, tarsome~~tata~~tarsus 15407; I ulna 15406, K Type humerus 15408; J Endomychura (?) sp. cranium dorsal view 15426; L, N, O, Palaelodus [illegible] tarsometatarsus 15423, distal, internal + anterior views; M. Mancalla cedrosensis referred tarsometatarsus 15425 ant view. Figures L, M, N, O natural size, all others approximately x $1\frac{1}{2}$.

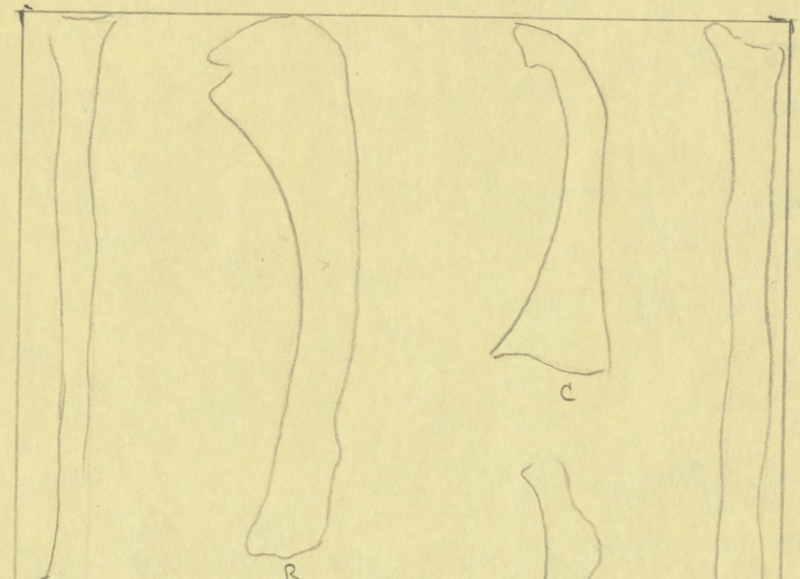

Plate 2

~~Skeleton~~ Elements from type skeleton of
Mancalla cedrosensis: A, D^R Tibiotarsus
internal and anterior views; B^R humerus anconal view;
C, G, J^R Coracoid, posterior, internal and anterior views;
H^R scapula, ~~dorsal view~~, E ulna ? view ?, F radius ? view ?, I ^{L}carpometacarpus int.
K^R femur (post. view)

Original was given
To Ted Downs March 3, 1971
for "Contributions"
Publ. would
not be possible
until after July 1971

PLIOCENE AVIAN REMAINS FROM BAJA CALIFORNIA

By Hildegarde Howard[1]

ABSTRACT: Seven species are represented in an Early Pliocene avifauna from marine deposits in three canyons in the southeastern part of Cedros Island. Predominant is a new species of flightless auk, *Mancalla cedrosensis*, represented by four incomplete skeletons as well as disassociated elements. Other new species described are *Puffinus tedfordi* and *Cerorhinca minor*. The primitive flamingo, *Megapaloelodus opsigonus* Brodkorb, is tentatively identified. A shearwater, gannet and murrelet (listed by genus only) complete the avifauna.

Footnote [1]

Research Associate in Vertebrate Paleontology, Los Angeles County Museum of Natural History.

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By Hildegarde Howard[1]

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Nov. 22, 1970

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INTRODUCTION

In 1964 and 1965 the University of California, Riverside, in cooperation with the University of Baja California, Ensenada, collected vertebrate fossils on Cedros Island. Through the kindness of Dr. Richard Tedford, who headed the field work, the bird remains were presented to the Los Angeles County Museum of Natural History.

Tedford's notes accompanying the collection indicate that the fossil-bearing marine deposits involved are "in the basal part of the northwesterly dipping Pliocene section as it crops out in deep canyons and ridges near the base of the escarpment which froms the high northern wall of Valle Blanca." This prominent valley, he states, runs east and west, draining much of the southeast corner of Cedros Island, with its mouth opening at the sea about 2 miles south of the "cannery village." The fossils were collected from marine sandstones that overlie unconformably the Tortuga Formation of Late Miocene (Temblor) age, and because of this relationship, they have been referred to the Almejas Formation of Mina (1957), whose type section occurs at Tortuga Bay on the nearby Viscaino Penninsula.

Dr. Frank Kilmer, of the Geology Department of Humboldt State College, California, who studied the invertebrate beds on Cedros Island, believes (personal communication) that the vertebrate-bearing ~~strata~~ ~~beds~~ sands may be early to middle Pliocene in age. Although these beds are so far not known to contain ~~contain no~~ invertebrates, he notes that they rest on diatomaceous strata ~~beds~~ of probable upper middle ~~Late~~ Miocene (Luisian) ~~age~~, and underlie coarsely clastic invertebrate-bearing deposits ~~beds~~ of probable mid-Pliocene age.

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revision per Kilmer June 16, 1971

With respect to the Miocene-Pliocene contact, most of the bird remains occurred in the lower 10-70 feet of the Pliocene deposits. They were taken from approximately 22 field collecting sites over a half a mile of strike in three canyons. From west to east the canyons were named by the field party: Arroyo Esqueletos, Arroyo Tiberon and Arroyo Delphin. Los Angeles County Museum of Natural History (LACM) locality numbers have been assigned to the collecting sites within these canyons based, in general, on their depth within the section. These are as follows (from lowest to highest within each canyon or ridge, and including from one to five field ~~sites~~ numbers): Arroyo Esqueletos, loc. nos. 65144, 65145, 65146 and 65147; Arroyo Tiberon, loc. nos. 65152, 65151, 65150; Arroyo Delphin, loc. nos. 65148, 65149; ridge between Arroyo Tiberon and Arroyo Delphin, loc. nos. 65154 and 65153.

AVIFAUNA

Predominant among the approximately 100 avian bones found are those of a heretofore undescribed species of the flightless auk, Mancalla. Other species (all extinct) represented in the collection by fragmentary elements are two shearwaters, a ~~sulid~~ gannet, a flamingoid species of the extinct family Palaelodidae, ~~and two auklets~~ an auklet and a murrelet,. The ~~complete avifauna~~ taxa ~~is~~ represented are as follows:

Puffinus tedfordi, n. sp.

Puffinus sp.

Morus sp.

Mega ~~Palaelodus~~ opsigonus ~~(Brodkorb)~~?

Cerorhinca minor n. sp.

Endomychura (?) sp.

Mancalla cedrosensis n. sp.

ANALYSIS OF SPECIES

Order Procellariiformes

Family Procellariidae - Shearwaters

Puffinus tedfordi, new species

Holotype: Proximal end of left tarsometatarsus, LACM 15386. Collected by Whistler and Tedford, August, 1965.

Locality: LACM locality 65151, Arroyo Tiberon, ~~approximately 70~~ 45-60 feet above Miocene-Pliocene contact; north side of Valle Blanca, 1½ miles south of cannery village, southeast corner of Cédros Island, Baja California, Mexico.

Formation and Age: Almejas Formation; Early Pliocene.

Diagnosis: Resembling *Puffinus opisthomelas* in gradual merging of internal calcaneal ridge with internal edge of shaft, but shaft broader, and proximal end relatively narrower and more evenly flared; anteriorly both edges of shaft forming well-defined ridges, with external edge more extended anteriorly; internal face of shaft sloping laterally so as to be plainly visible in anterior view in proximal half of bone.

Paratype: Incomplete tarsometatarsus LACM 15387; same data as for holotype. Although both proximal and distal ends are incomplete in this specimen, the contact of the internal calcaneal ridge with the shaft and the anterior shaft ridges are preserved and conform in character with the holotype. The paratype is important in providing a measurement of length between the distal and proximal foramina, showing the specimen to be within the range of 13 tarsometatarsi of *P. opisthomelas* in this dimension, but 28 per cent broader of shaft than the maximum for that species. Without this dimension of length, the stoutness of the shaft would suggest considerably greater length of the element.

Measurements: Holotype, breadth of proximal end 6.8 mm; least breadth of shaft 3.3 mm; greatest depth of external side of shaft 4.0 mm; depth of internal side of shaft below internal calcaneal ridge 2.7 mm. Paratype, length between proximal and distal foramina 32.2 mm; breadth of shaft 3.0 mm; depth of external side of shaft 3.9 mm; depth of internal side of shaft 2.7 mm.

Comparison with other fossil shearwaters: Only two other Pliocene shearwaters are known, both from California, *Puffinus kanakoffi* from San Diego and *P. felthami* from Corona del Mar. Tarsometatarsi of both are at hand. *P. tedfordi* resembles *P.* ital *kanakoffi* in the merging of the internal calcaneal ridge with the postero-internal edge of the shaft and approximates this species in length of the tarsometatarsus. It differs, however, in 20 per cent broader shaft, more evenly developed proximal end and visibility of the internal side of the shaft in anterior view. *P. felthami* differs from *P. tedfordi* in having the internal calcaneal ridge slightly inset mediad from the internal edge of the shaft and the posterior surface of the shaft adjacent to the ridge swollen, not flat as in *P. tedfordi*. *P. felthami* is broader proximally than *P. tedfordi*, the shaft is deeper but narrower; no measurement of length is possible.

Three Miocene west-coast shearwaters in which the tarsometatarsus is identified are at hand (*P. diatomicus*, cast; and *P. calhouni* and *P. priscus*, tentative identification Laguna Hills original material). All have the calcaneal ridge inset and the swollen shaft adjacent as in *P. felthami*. To judge from the figured type tarsometatarsus of *P. arvernensis* from the Miocene of France (Shufeldt, 1896, pl. 24, figs. 1,2) this specimen is shorter and stockier even than in *P. tedfordi*, but the external side of the shaft is not as deep

Other Miocene shearwaters are known only from the humerus. Using P. opisthomelas and P. griseus as points of reference for size, P. micraulax from Florida (as recorded by Brodkorb, 1966:161) would have been markedly smaller than P. tedfordi, whereas P. mitchelli and P. inceptor (both studied from casts) from California, and P. conradi (cast) from Maryland, would have been larger. Lambrecht's (1933:273) reference to P. aquitanicus and P. antiquus from the Miocene of France suggests that these species also were larger than P. tedfordi.

Puffinus sp.

A distal fragment of a humerus (LACM 15404) and a nearly complete ulna (LACM 15403) from the ridge between Arroyo Tiberon and Arroyo Delphin (LACM locality 65153) represent a larger species of shearwater than P. tedfordi. Except for the fact that the humerus shows the marked lateral compression of the shaft characteristic of the subgenus Puffinus, no reliable diagnostic characters remain on this fragment. The few measurements that can be made in comparison with the type humerus of the California Pliocene P. felthami indicate close similarity in size. The fragment is too poor, however, to assign or describe.

The ulna is well preserved, with only a small section of the shaft incomplete. The proximal end is narrow relative to its depth through the olecranon as in members of the subgenus Puffinus. The brachial impression is long (13.5 mm) and deeply depressed adjacent to the prominence for the anterior articular ligament. The bone is slightly more slender than the ulna of P. griseus and markedly shorter, being about midway between this species and P. kanakoffi. As the ulna is not known in most of the previously described fossil shearwaters, it would be unwise to attempt assignment of the Cedros Island bone.

Measurements of ulna LACM 15403: Greatest length (with possibly a section of shaft missing) 86.7 mm; breadth across proximal cotylae 7.8 mm; depth from cotylae through olecranon 9.2 mm; breadth of distal trochlea 5.1 mm; depth of external crest of trochlea 6.9 mm; dimensions of middle of shaft 4.1 x 4.8 mm.

A very broad distal half of a tibiotarsus (LACM 15378) from Arroyo Tiberon (LACM locality 65151) exceeds even *P. griseus* in shaft breadth. It is doubtful that it is allied with the wing bones here discussed.

Order Pelecaniformes

Family Sulidae - Boobies and Gannets

Morus sp.

A distal end of a left humerus (LACM 15413) from Arroyo Delphin (LACM locality 65148) is crushed and broken in several important diagnostic areas. However, the long attachment of the anterior articular ligament and the positions of the attachments on the entepicondyle and ectepicondyle suggest alignment with the gannets (genus *Morus*) rather than with the boobies (genus *Sula*). The olecranal fossa, also, is seemingly less depressed than in *Sula* although the broken borders of the fossa may create a false visual impression of the area.

One portion of the specimen, fortunately preserved, is the well developed entepicondylar area, which serves immediately to distinguish it from *Sula humeralis* from the San Diego Pliocene. *S. humeralis* is similar in size to the Cedros Island bone, but is described (Miller and Bowman, 1958:10) as being underdeveloped in the entepicondylar area. Size alone separates the Cedros xxxxx members of the genus *Morus*
bone from other west-coast Tertiary sulids
(larger than *Morus vagabundus* and smaller than *Morus lompocanus*). However, it closely approximates in breadth a humerus from the

east coast referred to Morus loxostyla (Wetmore, 1926:467), a species known only from the Miocene. Assignment of the imperfect Cedros bone is inadvisable.

Measurements: Breadth of distal end 20.5 mm; length of attachment of anterior articular ligament 9.8 mm.

Order Ciconiiformes: Suborder Phoenicopteri - Flamingos

Family Palaelodidae - Primitive Flamingos

Megapalaelodus opsigonus Brodkorb (?)

A distal end of a left tarsometatarsus (LACM 15423) and a fragment of the distal end of a tibiotarsus (LACM 15422), both from Arroyo Delphin locality 65148, 10 feet above the Miocene-Pliocene contact, are assigned to the family Palaelodidae. In the tarsometatarsus the palaelodid characters are seen in the shape and position of the internal and external trochleae as compared with the tarsometatarsus of *Phoenicopterus*, as follows: (1) internal trochlea arising from the shaft well in front of of the posterior margin of the middle trochlea and rounding upward at the tip; (2) external trochlea also rounding upward posteriorly and its external lip more elevated than its internal lip. The contours of the tibiotarsus are badly worn, but the specimen is referred to the Palaelodidae on the basis of the following characters: (1) distal articular surface with low median ridge, and deep, pit-like depression on each side posterior to the condyles; (2) small, lateral papilla present above the external condyle anteriorly, but no large anterior intercondylar tubercle as in *Phoenicopterus*.

The family Palaelodidae is best known from the several species of the genus *Palaelodus* recorded from the Miocene of France and Germany. Previous records in North America are assigned to the (genotype) and *M. opsigonus* Brodkorb. The former was described (A. Miller, 1944:86) on the basis of a large distal end of tarsometatarsus from the Miocene of South Dakota. Later, L. Miller (1950:70) referred a distal end of a tibiotarsus from the Miocene of California to the same species. *M. opsigonus* was described (Brodkorb, 1961:173) from a proximal end of a tarsometatarsus found in lower Pliocene deposits in Oregon.

Characters of the Cedros Island tarsometatarsus are as follows: internal trochlea well elevated above middle trochlea and posteriorly rotated toward the center of the shaft; proximodistal dimension (height) 90 per cent of its antero-posterior depth; internal surface flat and bordered posteriorly by a long, heavy ridge, deflected away from the shaft. External trochlea laterally compressed; proximo-distal dimension 89 per cent of its antero-posterior depth; external surface with deep depression near posterior tip. The specimen was compared with casts of the comparable portion of the tarsometatarsus of *Palaelodus ambiguus* and *Megapaloelodus connectens*, the types of their respective genera. Resemblance is closer to *P. ambiguus* in the elevation of the internal trochlea and the lateral compression of the external trochlea, but closer to *Megapaloelodus* in the relative height to depth of the internal and external condyles. The internal surface of the internal trochlea is flatter than in either of the other forms, but is furthest removed from *P. ambiguus*, in which this surface is deeply depressed. The degree of deflection of the posterior tip of the internal trochlea away from the shaft is, perhaps, closer to the condition in *Palaelodus* than in *Megapaloelodus* although this area in *M. connectens* is incomplete. Miller, however, (1944:86) notes less abrupt deflection of this area as one of the characters distinguishing *M. connectens* from *Palaelodus*. The other character that he emphasizes concerns more pronounced development of the outer rim of the external trochlea. The angular measurement that he gives (formed with the axis of the shaft by a line from the inner to the outer rim of this trochlea) I have been unable to duplicate. Possibly, however, the greater inflation of this trochlea as compared with that of the Cedros specimen is a reflection of this character.

In breadth of the distal end, taken at right angles to the axis of the shaft, the Cedros tarsometatarsus is 10 per cent narrower than that of *M. connectens*, and 6 per cent broader than that of the largest species of *Palaelodus* (*P. goliath*). Compared with the proximal end of the tarsometatarsus that forms the type of *Megapaloelodus opsigonus*, the Cedros bone is approximately the same size. Both specimens measure 19.6 mm in breadth of their respective articular ends. There is some variation in relative breadth of articular ends of this element as noted in *Palaelodus* and *Phoenicopterus*. Milne-Edwards (1867-1871, 2:78) records the proximal ends of *P. gracilipes* and *P. ambiguus* as 2 mm broader than the distal, but shows the proximal end of *P. crassipes* to be 0.8 mm narrower than its distal end. In two modern tarsometatarsi of *Phoenicopterus ruber* the proximal ends are narrower than the distal; in another *P. ruber* and in a specimen of *P. antiquus*, both ends are the same breadth.

The agreement in size between the Cedros tarsometatarsus and that of *M. opsigonus*, coupled with the fact that both come from deppsits of early Pliocene age, strongly suggests that they are representative of the same species. The Cedros tarsometatarsus, therefore, is tentatively referred to *M. opsigonus*. The fact that the Cedros bone does not appear to agree with *Megapaloelodus* in the two characters particularly emphasized in Miller's (1944:86) description of *M. connectens* is not considered a deterrent in view of the over-all comparison with both *P. ambiguus* and *M. connectens*. Milne-Edwards notes considerable variability among the several species of *Palaelodus*, and similar variability may have existed in *Megapaloelodus*. Furthermore, there is also a possibility that *Megapaloelodus* itself is but another specific variant of *Palaelodus*.

The fragmentary distal portion of tibiotarsus from Cedros Island is commensurate in size with the tarsometatarsus, and is, therefore, also tentatively assigned to *P. opsigonus*. The only character of any possible importance below the family designation in this poorly preserved specimen is the large oval opening at the distal margin of the supratendinal bridge. The tibiotarsus referred to *M. connectens* is said to have a round, rather than an oval opening (L. Miller, 1950:70).

Measurements of tarsometatarsi of *Megapaloelodus* and *Palaelodus*

	Cedros Id. LACM 15423	*M. connectens*	*P. ambiguus*	*P. goliath*
Breadth of distal end at right angles to axis of shaft	19.6 mm	21.7 mm	12.0 mm	18.5 mm
Height of internal trochlea	12.8	12.2	6.8	...
Depth of internal trochlea	14.2	14.2	8.9	...
Height of external trochlea	12.0	12.1	6.0	...
Depth of external trochlea	13.5	14.0	8.7	...

Order Charadriiformes: Suborder Alcae

Family Alcidae, Subfamily Alcinae - Auks, etc.

Of eight small alcid bones, six show relationship to the group which includes the Rhinoceros Auklet and the Puffins. The three genera involved (*Cerorhinca*, *Lunda* and *Fratercula*) so closely resemble each other in skeletal characters, that the term "puffin" might properly be applied to all three. Similar characters are: humerus with long, hooked tip of internal tuberosity, deeply undercut head and medially expanded pectoral attachment proximally; ulna with abrupt flare from shaft to internal cotyla, narrow notch between olecranon and tricipital attachment (viewed proximally)✓, area anconally bordering attachment of anterior articular ligament uneven in profile as viewed from anconal side (more expanded proximally than distally), distally, carpal tuberosity long and prominently projected laterally; coracoid with long procoracoid and foramen very low; tarsometatarsus with broad, flat shaft. It is only by weighing a number of small details that the fossils are assigned to *Cerorhinca*. All elements are 25-30 per cent smaller than those of *Cerorhinca monocerata*, and the fossil species is described as new.

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Cerorhinca minor, new species

Holotype: Proximal end of right humerus, LACM 15408, collected by Whistler and Jefferson, ✓July, 1964.

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Locality: LACM locality 65153, ridge between Arroyo Tiberon and Arroyo Delphin; 45-60' above Miocene-Pliocene contact; north side of Valle Blanca, 1½ miles south of cannery village; southeast corner of Cedros Island, Baja California, Mexico.

Formation and Age: Almejas Formation; Early Pliocene.

☆, 1st draft used 15405 coll'd by Tedford Aug 1965, *Diagnosis*: Head smoothly rounded on lower margin; deep channel undercutting head and proximo-medial edge of pectoral attachment; internal edge of channel limiting medial extent of capital groove and aligned with median crest; pneumatic fossa more round than oval; approximately three-fourths the size of *C. monocerata* humerus.

Referred specimens: Proximal half of ulna, LACM 15406, and incomplete tarsometatarsus, LACM 15407 from the type locality; incomplete right proximal end of humerus, LACM 15420 and upper end of coracoid, LACM 15421, from Arroyo Delphin (LACM locality 65148). Tentatively referred distal half of ulna, LACM 26572 from Arroyo Tiberon (LACM locality 65151).

Description of referred material: Humerus LACM 15420 is broken but resembles the type in all areas preserved. Proximal end of ulna with shorter, straighter, more blunt olecranon than in *C. monocerata*, attachment of anterior articular ligament shorter and broader, and internal side of shaft more rounded, resulting in less bladelike shaft; 72 per cent of size of *C. monocerata* in breadth of proximal end. Tentatively assigned distal half ~~end~~ of ulna (LACM 26572) larger than proximal half ~~end~~ in shaft breadth and approximately 82 per cent of the size of *C. monocerata* in trochlea tr depth through the external crest of the trochlea. Coracoid with straight upper border of long procoracoid as in *Cerorhinca* (*Lunda* and *Fratercula* with upcurved tip); triosseal canal broadly rounded (lacking keellike raised area slightly anterior of center found in *Lunda* and *Fratercula*); three-fourths the ital size of *C. monocerata* in breadth and further distinguished by less expanded head, less undercut by triosseal canal; the for- hyphen amen was evidently low on the procoracoid as at least half the procoracoid is preserved and the foramen is not in evidence.

The tarsometatarsus is broken above the tibialis anticus tubercles and through the upper portion of the distal trochleae; shaft broad and flat and well depressed on anterior surface; resembling Cerorhinca in distinction to Lunda and Fratercula in less internal flare of trochlear region and presence of small, slitlike depression separating base of internal trochlea from middle trochlea; approximately three-fourths the size of C. monocerata in breadth of shaft at upper level of distal foramen.

Measurements: Type humerus, breadth proximal end 10.5 mm; dimensions of shaft ~~3.0~~ 3.1 x 4.2 mm. Ulna LACM 15406, breadth across proximal cotylae 5.0 mm; depth from internal cotyla to olecranon 5.5 mm; dimensions of shaft 2.3 x 3.3 mm. Ulna LACM 26572, depth external crest of distal trochlea 5.4 mm; dimensions of shaft 2.8 x 3.8 mm. Coracoid LACM 15421, length from below scapular facet to head 9.6 mm; breadth through triosseal canal 2.9 mm; breadth of head 3.9 mm. Tarsometatarsus LACM 15407, least breadth of shaft 2.7 mm; depth of shaft 1.9 mm; breadth of shaft at upper level of distal foramen 4.2 mm; length from distal foramen to top of tibialis anticus tubercles 12.8 mm.

Comparison with previously recorded fossil Cerorhinca: Cerorhinca dubia from the Miocene of Lompoc, California is

K known only from the leg bones. The tarsometatarsus (as recorded by Miller, 1925:116, and as examined on a cast of the type) is only 2 per cent shorter than that of C. monocerata, hence notably larger than that of C. minor. The only other Tertiary record of Cerorhinca is from the late Miocene of Laguna Hills, California. A proximal end of an ulna and a fragment of a humeral shaft were assigned only as Cerorhinca sp. (Howard, 1968:16). The ulna (LACM 18274) is 30 per cent larger than in C. minor.

LACM 18274
[ulna 6.5 prox br. ^ 7.2 depth olecranon]

? *Endomychura* ~~(?)~~ sp. - Murrelet

The two remaining small alcid bones consist of a dorsal cap of a cranium (LACM 15426) from Arroyo Esqueletos (LACM locality 65144) and a proximal fragment of a humerus (LACM 26571) from Arroyo Tiberon (LACM locality 65151). Both are commensurate in size with the elements assigned to *C. minor*. However, they show closer relationship to the murrelets. On the cranium, the depressions above the orbits form evenly rounded, short arches, and the frontal area is well vaulted adjacent to them. This condition appears in both *Endomychura* and *Synthliboramphus*. The humerus is closer to that of *Endomychura* in the very shallow depression below the head (even shallower than in either *E. craverii* or *E. hypoleuca*). Neither specimen is sufficiently complete to permit of definite assignment.

Subfamily Mancallinae - Flightless "Auks"

Bones of the flightless auk, *Mancalla*, occurred at all LACM localities, and from approximately 5 feet (one bone) to approximately 120 feet (one bone) above the Miocene-Pliocene contact, with greatest concentration between 10-70 feet. Four incomplete skeletons and 50 disassociated elements are represented, making a total of more than 80 bones.

Previously described species of this genus (see Howard, 1970 for review) have come from the Pliocene of California: *Mancalla californiensis*, *M. diegense* and *M. milleri*. A possible ancestral form, *Praemancalla lagunensis* is recorded from the late Miocene of California. The bones from Cedros Island are close in size to those of *M. diegense*, but structural peculiarities serve to distinguish most of the elements. The Mexican form is, therefore, described as a distinct species.

Mancalla cedrosensis, new species

Holotype: Associated skeletal elements of one individual, LACM 15373, including essentially complete right scapula, coracoid, humerus, ulna, femur and tibiotarsus, and left, ulna, radius and carpometacarpus; also including distal ends of right radius, right carpometacarpus and left tibiotarsus, extreme tip of proximal end of right tarsometatarsus, proximal ¼ of left femur, and several fragmentary thoracic and cervical vertebrae. Collected by R. Tedford, 1965.

Locality: LACM locality 65147 (Tedford field no. 1296), east branch of Arroyo Esqueletos, approximately 70 feet above Miocene/Pliocene contact; 2 miles south of cannery village, southeast corner of Cedros Island, Baja California, Mexico.

Formation and Age: Almejas Formation, Early Pliocene.

Referred Material: Three associated skeletons: LACM 15425 from LACM locality 65144 (Arroyo Esqueletos, approximately 25 feet above x~ Miocene/Pliocene contact) including porximal ends of left femur and tibiotarsus, distal end of right tibiotarsus, complete right tarsometatarsus, fragment of pelvis and vertebrae; LACM 23739, also from LACM locality 65144, including right and left femora, left tibiotarsus (distal end) and complete left tarsometatarsus; and LACM 15410 from LACM locality 65150 (Arroyo Tiberon, approximately 70 feet above Miocene/Pliocene contact) including right and left scapulae and coracoids, furcula, crushed sternum, and a carpometacarpus. Also unassociated elements from all localities, consisting of a rostrum, 2 scapulae, 1 coracoid, 10 humeri, ~~14~~ 15 ulnae, 3 radii, 5 carpometacarpi, 1 femur, 4 tibiotarsi, 6 7? tarsometatarsi and 3 vertebrae.

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50

Diagnosis: Coracoid relatively short and heavy (ratio of breadth below furcular facet to length more than 12 per cent), ratio of length of coracoid to length of humerus 59 per cent); tip of furcular facet blunt but up-turned. Humerus with internal contour from shaft through bicipital crest broadly and gradually curved; area below head, between pectoral attachment and pneumatic fossa oval and deeply depressed. Olecranon of ulna extending beyond shaft in ulnar contour. Length of process of metacarpal 1 of carpometacarpus more than 44 per cent of total length of bone. Femur with obturator ridge relatively short, straight in internal contour, and with well-marked depression internal to ridge. Tibiotarsus with distal internal ligamental prominence a distinct, rounded papilla below the level of the proximal edge of internal condyle; external ligamental prominence negligible. Tarsometatarsus (based on referred material) flared proximally and distally, shaft depressed anteriorly with bordering ridges sharply defined.

Comparisons: In all qualitative characters separating *M diegense* and *M. milleri* from *M. californiensis*(Howard, 1970, Table I), *M. cedrosensis* is closer to *M. diegense* and *M. milleri*. In the characters that distinguish *M. diegense* from *M. milleri* (Howard, op. cit., Table IV), *M. cedrosensis* resembles *M. diegense* in the projecting anterior edge of the furcular facet of the coracoid and in the proximal flare of the tarsometatarsus, but the borders of the metatarsal shaft are more sharply defined. In the femur, the depth of the depression internal to the obturator ridge resembles the condition in *M. milleri*, but the ridge is shorter. In the tibiotarsus, the distal internal ligamental prominence is more prominent than in either *M. diegense* of *M. milleri*, but seemingly is closer to the latter in placement below the level of the proximal border of the condyle; the poor preservation of the San Diego specimens somewhat obscures the exact position of the prominence; the external ligamental prominence is negligible as in *M. milleri*.

Ital

#17

M. cedrosensis is distinct from both *M. diegense* and *M. milleri* in the contour of the humerus from shaft to bicipital crest, being more broadly and gradually rounded even than in *M. milleri*; also distinct is the oval shape of the area of origin of the external head of the triceps below the humeral head; in both California species this area is broader and of generally angular contour at the junction of the head and pectoral attachment. Distinction is noted, also, in the ulna in which the olecranon is more prominently developed and extends slightly beyond the shaft in ulnar contour.

The type of *M. cedrosensis* provides, for the first time, an accurate guide to the proportionate dimensions of the skeleton in a species of *Mancalla*. It is 12-16 per cent longer than the average for *M. milleri* in all represented elements except the coracoid, and is 8 per cent longer in this element. It is essentially equal to the average of *M. diegense* in length of ulna, carpometacarpus and femur, 5-7 per cent shorter in humerus, tibiotarsus and, probably, tarsometatarsus (this element is incomplete in the type), and 12 per cent shorter in the coracoid. Compared with the 59 per cent ratio of length of coracoid to length of humerus in the type of *M. cedrosensis*, ~~the average~~ ratio in both *M. diegense* and *M. milleri* is 64 per cent, based on averages.

Compared with a specimen of present-day *Uria aalge* (LACM Bi480 which is of minimum size for the species in most elements), the type of *M. cedrosensis* shows greatest difference in 116 per cent longer coracoid and femur, but 13 per cent shorter humerus, 18 per cent shorter carpometacarpus and 53 per cent shorter ulna. The tibiotarsus is 2 per cent longer. The tarsometatarsus in the type is incomplete but estimating its length from the breadth of the proximal end, it was probably very nearly the same length as in *U. aalge*.

ital

These proportions differ somewhat from those computed for the San Diego Mancalla material (Miller and Howard, 1949:207) which, we now know, were based on two species (Howard, 1970). With unequal representation of the large and small species, these prior figures overemphasized the large size of the coracoid on one hand, and the small size of the humerus, carpometacarpus and ulna on the other; the length of the femur was also underestimated.

Measurements of Type, LACM 15373: Coracoid, length (from head to sternal facet) 43.2 mm, breadth across furcular facet 7.3 mm, distance from below scapular facet to head 15.6 mm, least breadth of shaft below procoracoid 5.3 mm, breadth immediately below furcular facet 5.3 mm. Humerus, length from head to internal condyle 72.4 mm, breadth of proximal end 17.9 mm, breadth of distal end 7.2 mm, length from head to distal edge of deltoid crest 48.8 mm. Scapula, breadth across articular end 12.6 mm. Ulna, length from intercotylar ridge to internal condyle 29.5 mm, depth of proximal end through olecranon 9.5 mm, breadth across proximal cotylae 6.5 mm, breadth of shaft at middle 4.2 mm, depth of shaft 6.2 mm. Radius greatest length 29.0 mm. Carpometacarpus, length to end of metacarpal II 35.8 mm, length of process of metacarpal I 16.0mm (est.). Femur, greatest length 54.7 mm, depth through trochanter and obturator ridge 9.2 mm, greatest breadth of distal end 10.6 mm. Tibiotarsus, length from proximal articular surface to distal condyles 83.9 mm, breadth distal condyles 9.4 mm, depth distal condyles 8.8 mm. Tarsometatarsus, breadth of proximal end 10.2 mm.

19

Checked & copy

Size Range (in ~~millimeters)~~ mm.) of *Mancalla cedrosensis*,

lc

Compared with *M. diegense* and *M. milleri*

	M. cedrosensis			*M. diegense*			*M. milleri*		
	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.
CORACOID									
Length	47.5	45.3	43.2	54.0	49.1	47.5	43.5	40.0	38.5
Breadth below furcular facet	6.0	5.5	5.2	6.3	5.8	5.4	5.1	4.9	4.0
SCAPULA									
Breadth proximal end	14.2	13.7	12.6	14.4	13.5	12.5	11.8	10.9	10.3
HUMERUS									
Length	80.0	73.5	69.5	85.2	76.5	71.0	66.6	62.7	56.4
Breadth proximal end	20.1	17.9	17.0	20.3	18.7	17.3	16.4	15.3	14.2
ULNA									
Length	31.7	30.0	28.3	32.1	29.4	28.0	27.0	25.3	23.6
Breadth proximal end	7.2	6.6	6.2	6.6	6.4	5.9	5.7	5.2	4.5
RADIUS									
Length	31.1	29.3	27.3	31.8	30.9	29.6	26.9	25.1	24.2
Greatest depth shaft	6.1	5.6	5.4	6.4	6.35	6.3	5.6	4.9	4.6
CARPOMETACARPUS									
Length	36.0	35.4	34.9	37.2	35.6	35.0	33.2	31.6	29.6
Length process metacarpal I	16.0	15.6	15.4	15.5	15.3	15.2	14.5		12.6
Depth proximal end through metacarpal I	11.1	10.5	10.2	11.0	10.3	9.7	9.5	9.1	8.8
FEMUR									
Length	56.5	55.4	54.7	57.0	55.2	53.8	51.1	47.9	45.0
Breadth of distal end	10.8	10.6	10.4	11.1	10.2	9.7	9.3	9.0	8.4
TIBIOTARSUS									
Length		83.9		98.5	90.2	81.0	77.5	74.9	72.0
Breadth of distal end	9.5	9.2	9.0	10.7	9.0	8.2	7.9	7.2	6.5
TARSOMETATARSUS									
Length	42.0	39.2	37.3	43.6	39.9	38.0	36.0	34.0	31.1
Breadth proximal end	10.9	10.3	9.9	10.7	9.6	8.7	8.4	8.0	7.2

SUMMARY AND CONCLUSIONS

The seven species represented in the Early Pliocene avifauna of Cedros Island are undoubtedly all extinct. Three, however, are represented by material that is unsatisfactory for assignment beyond the generic level. One is tentatively allocated to *Megapaloelodus opsigonus*, a primitive flamingo known only from the Early Pliocene of Oregon. Three are described as new: *Puffinus tedfordi*, *Cerorhinca minor* and *Mancalla cedrosensis*. The genus *Puffinus* is well represented in the Tertiary of the west coast, with five Miocene and two Pliocene species previously recorded from California. *Cerorhinca* has only two previous fossil records, both from the Miocene of California. *C. minor* is the smallest known species of the genus. *Mancalla cedrosensis* adds a fourth species to those recorded for this genus of flightless auks; previous records are all from California, and presumably all Pliocene.

The avifauna of Cedros Island, although not nearly as abundantly represented as that of the somewhat later Pliocene of San Diego, California, is similar in the predominance of *Mancalla*. The absence of immature bones indicates that the area may have been a congregating site but not a nesting site for these flightless birds. This is thought to be true, also, of the San Diego site. The Cedros bones, however, are much better preserved than most of those from San Diego, suggesting that they were less subject to weathering and may have been deposited further offshore. In addition to *Mancalla*, other similarities of occurrence in the two avifaunas are shearwaters, sulids and alcids although in no instance are the species the same. Grebes and loons, present at San Diego are lacking at Cedros. On the other hand, the Cedros primitive flamingo, *Megapaloelodus*, represents a group that has not been noted at San Diego.

The Early Pliocene fauna of Juntura, Oregon (including fish, reptile, bird and mammal) indicates a pond, lake or river community, not marine (Shotwell, 1963:15). The Megapaloelodus of this fauna is the only avian form similar to the avifauna of Cedros Island. Other Juntura birds include cormorant, goose, ducks and coot.

The two bones from Cedros Island assigned to Puffinus sp. suggest a shearwater the size of P. felthami described from the Early Pliocene of Corona del Mar, California, but positive identification is impossible. The scant remains from Corona del Mar include but one other species, Mancalla californiensis.

In three of the other Pliocene marine localities in California, Mancalla is the only bird recorded: M. californiensis from the Third Street tunnel, Los Angeles; M. diegense from Humboldt County (age not confirmed) and Laguna Hills, Orange County. A fourth locality, in Monterey County, has a single record of a loon, Gavia concinna.

The addition of the Cedros avifauna to the fossil record brings to 19 the number of specifically assigned avian forms known from the marine Pliocene of the west coast.

Manuscript submitted March 3, 1971

Remains from the Lower Pliocene of Corona del Mar, California are very scant. Only *Mancalla* and a shearwater are recorded (Howard, 1949:193). The *Mancalla* (*M. californiensis*) is notably different from *M. cedrosensis*, but the shearwater, *P. felthami*, is possibly represented by the humerus and ulna from Cedros Island assigned to *Puffinus* sp.

A single species is recorded from each of the other four west coast marine Pliocene localities (all in California): *Mancalla californiensis* from the Thirds Street Tunnel, Los Angeles, and *Mancalla diegense* from Humboldt County (age at this locality is not confirmed), and Laguna Hills; *Gavia concinna* is the one avian record from a Monterey County locality.

The EarlyPliocene fauna from Juntura, Oregon (including fish, reptile, bird and mammal) indicates a pond, lake or river community, not marine (Shotwell, 1963:15). *Megapaloelodus opsigonus*, of this fauna appears to be represented at Cedros Island. Other Juntura birds include cormorant, goose, ducks and coot.

The addition of the Cedros avifauna to the fossil record brings to 19 the number of specifically assigned avian forms known from the marine Pliocene of the west coast.

ACKNOWLEDGMENTS

The generosity of Dr. Richard Tedford, now of the Department of Vertebrate Paleontology, American Museum of Natural History, in presenting the Cedros Island avian material to the Los Angeles County Museum of Natural History and in providing critical data pertaining thereto for this study, is gratefully acknowledged. The species *Puffinus tedfordi* is named in his honor.

My thanks are extended to Dr. Joel Cracraft for providing casts of *Palaelodus* and *Megapaloelodus*, and to him and to Drs. Frank Kilmer and Pierce Brodkorb for discussion and information provided. Posthumous recognition and appreciation go to Professor Loye Miller for reading and discussing the section on *Mancalla* a few weeks prior to his death.

Except for the Palaelodid specimens, comparative material examined, both Recent and fossil, was available at the Los Angeles County Museum of Natural History as original material or casts. I am continually grateful to the staff of that Museum for many courtesies and kindnesses.

Photographs are by Lawrence Reynolds.

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Howard -- Baja California

Legends for figures

Figure 1. A, B, E, F, *Puffinus tedfordi* n. sp. tarsometatarsi; A, F, paratype; B, E, type. C, *Puffinus* sp. D, G, H, J, *Cerorhinca minor* n. sp.; D, tarsometatarsus 15407; G, ulna 1540~~7~~6; H, coracoid 15421; J, type humerus. I, *Endomychura*? sp. cranium 15426. K, M, N, *Megapaloelodus opsigonus*? tarsometatarsus 15423, distal, internal and anterior views. L, *Mancalla cedrosensis* n. sp., tarsometatarsus 15425. Figs.A,B,D,E,F,G,H,I,J, approx. X 1½; figs. C,K,L,M,N approx. X 1.

Figure 2. Skeletal elements from type specimen of *Mancalla cedrosensis* LACM 15373: A, D, tibiotarsus internal and anterior views; B, humerus; C, G, J, coracoid posterior, internal and anterior views; E, ulna; F, radius; H, scapula; I, carpometacarpus; K, femur. All figures slightly more than natural size.

Howard -- Baja California

Legends for figures

Figure 1. A, B, E, F, *Puffinus tedfordi* n. sp., tarsometatarsi; A, F, paratype, B, E, type. D, G, H, ~~K~~J, *Cerorhinca minor* n. sp.; D, tarsometatarsus 15407, G, ulna 1540~~3~~6, H, coracoid 15421, J, type humerus. I, *Endomychura*?sp. cranium 15426. K, M, N, *Megapaloelodus opsigonus* ? tarsometatarsus 15423, distal, internal and anterior views. L, *Mancalla cedrosensis* n. sp., tarsometatarsus 15425.

Oct 7, 1970

Measurements Puffinus various locs, compared Cedros

Tarsus	P. kanakoffi tarsus 2126	2572	X → type I122	P. felthami	P kanakoffi 2114	✓ Cedros 15387	✓ Type Cedros 15386		P calhouni 17582	P. calhouni ~~et~~ priscus 17538	P? Laguna Hills	Living P. pacificus cuneatus	P. cuneatus from ME Platter	P. calhouni 17550	P cal 17552		P kanakoffi 2821	V Cedros 15407	unid Shark tooth 17505	unid Sharktooth 17503
Length bet prox & dist foramina	34.?	32.7	32.5	—	?	32.3	—					35.1	40.7			ulna	[illegible]			
Br dist end bottom of foramen	—	4.9	4.6?	—		5.1	—					5.2	5.4	—	—	gr length	75.7	86.8		
Br dist end top of foramen	—	4.0	3.9	—		4.2	—					4.4	4.7	7.1/77	6.9/7.7	B/d prox	7.7/8.2	8.5/9.0	8.6/9.9	6.5/7.9
Br prox at lower edge int calc ridge	3.7	3.5	3.75	4.4		4.3	4.3		3.8	4.5	4.8	4.3	4.7	above mid 3.9	—	Br sh mid	3.55	4.3		
Br proximal cotyla	6.9	6.7	6.45	7.3 ap	7.1	—	6.75		—	6.8		7.25	9.8	—	18245 3.35	depth ext dist tarsus	6.1	6.9	18697 6.4	17504 6.35
Br sh middle	2.4	2.5	2.7	2.8		3.0	3.3		2.5	mid? 2.9	mid? 3.6	2.9	3.5		Br sh 3.6					
gr depth shaft ext	3.3	3.5	3.75	4.3	3.5	4.0	4.0		4.35	4.4	5.2	3.4								
Br. hypotarsus at base	—	3.8	4.0	—		—	4.4		3.7	4.6?	—	4.1								
gr length	46.7	45.5	45.1	—		45.0 est.	—					47.6	58.8							
least br shaft	2.4	2.5	2.7	2.75	2.7	3.0	3.3		2.5		Boraussa 18140	Pt unid 17502	→ Sharktooth Hill							
Humerus	P. kanakoffi 2516	2116	2120	2648	2140	2240A	P felthami + type X	P conradi cast type	✓ Cedros 15403	P. priscus cast type	P. priscus ref. Sharktooth 18140	P. priscus referred	P. mitchelli type cast	→ ref. R 17500	L 17500	P. calhouni 17539	17540	cast P. inceptor		
Least/gr shaft dimens above ext epic	3.9/7.0 5590	3.0/6.1 4990	3.6/6.2 5890	3.7/6.0 6190	3.7/6.9 5340	—	4.0/7.7 5240	5.2/8.6 6490	4.4/7.8? 5690 4.5 8.3?	3.85/6.6 5990	3.8/6.6 5790	3.8/6.5 5890	4.3/7.8 5540	4.5/8.0 5640	4.6/7.6 6080	3.8/6.3 6090	3.4/6.6 5190	4.1/7.1 5780		
Depth ext cond.	6.7	6.7	6.3	—	6.7	6.6	7.45	8.6	7.65	7.0	7.0	7.1	7.4	8.4	8.0	6.5	—	7.5		
ht ect epi above dist end	9.9	9.6	9.1	—	9.55	9.4	10.9	12.0	10.4? ~~11.1~~	9.9	10.2	—	11.0	11.4	11.6	9.1	—	10.2		
Length to ext cond.	85.1	—	—	—	—	—	—	—	—	—	—	—	—	—	98.1	—	—	—		
Br. dist condyles	—	—	7.6	—	7.95	8.0	8.7	9.7	—	7.5	7.4	7.5	8.4	9.3	9.1	7.0	—	9.9		
L/Br brach imp	4.1/2.6		4.0/2.4	Cedros 15407			4.1/3.0	3.9/5.6	4.9/2.8 X	4.5/2.5	4.6/3.2	4.0/2.7	5.4/3.4	5.1/3.6	4.9/3.9	3.6/2.7	3.2/2.4	5.0/2.8		
Br ext condyle	3.7		3.4				4.1	3.8	3.65	3.5	3.7	4.0	4.2	4.3	4.5	3.4	—	3.7		
Br prox	7.7/8.2			7.9/9.0																
Br shaft mid	3.55			4.3																
depth dist [illegible]	6.1			6.9																

humerus
ulna, tarsus
P. opistho. 51, 554

P. pacificus cuneatus 1375 tarsus, humerus, ulna tibia
San Benedicto Id, Mexico

dist
Pterodroma sandwichensis (Hawaii) ulna, humerus, tarsus 1731

x Puffinus gravis 18873, mass, ulna humerus, tibia tarsus

x P. griseus 50 ~~[illegible]~~ 577 ulna humerus, tarsus, tibia
ulna br. 4.0% length

x P creatopus 662

creatopus ulna
4.7% of length

Resemblance tarsus – broader than all, but int calc. ridge like
opistho, pacificus, Pterodroma (longer in this sp however)

Resemblance ulna – depth of brach. imp. & position rel. to lig attach
as in P. gravis;
shape of lig. attach like opistho but brachial
imp. shallower in opistho
Rel. narrow deep prox end like opistho

prox br 8.9% length
9.2% in opistho
8.8 griseus
7.8 gravis

Resemblance humerus – narrow, deep shaft like opistho & 2nd by griseus
others less compressed laterally as viewed from
palmar side

meas. of Puffinus cinereus from ME vol 1 p. 304
length of tarsus 55 mm.
ratio tarsus & tibia 100:196
length femur 40 mm
ratio metatars. to femur 100: 72

4.7? x 8.2? dimension of humeral shaft above ectepicondylar
process taken from ME pl. 52 (vol. 1) ~~pp~~ figs 7 & 8
Depth ext cond humerus from fig. 7 of above plate is 7.5 mm? or 8.0? mm
Ht ectepi process 12.0 on fig. 7 also.

meas. of P. arvernensis from Shufeldt 1896, pl 24, figs. 1-2, Proc. Acad. Nat Sci Phila.
"Fossil bones of birds & mammals from Grotto Pietro Tamponi & Grive-St. Alban.
Length tarsus between foramina 30.0 mm, gr length 41.7 mm
Br. prox 7.3, br sh 3.25 (middle), 5.2 (dist edge dist foramen), 4.3 (prox edge dist foram
3.8 (about at end of calc. ridge. Dept ~~int~~ ext side shaft 3.1

Oct 1970

~~[illegible]~~rdi Cedros Id.

Puffinus ~~sp.~~ P-1

Ulna 86.7 gr. length griseus 108.2, opistho 77.0

# 65153 / 15404

8.0 br. cotylae (prox " 9.2 " 7.3

6.9 depth ext side dist trochlea, gris. 7.2 " 5.7

9.1 depth prox end (bar straight across cotylae (palmad) → gris 9.3 " 8.4

4.2/4.8 br/depth sh. middle gris 4.3/4.6 opistho 3.5/4.1

Closest in length to Tepusquet Canyon Puffinus (unrecorded)

Notably larger than P. diatomicus, Too long for kanakoffi (75.7)

Tarsus 65151 / 15386

32.8 - length from foramen to foramen

? 45.0? est. over-all length

3.0 br shaft (middle) (kanakoffi 2.6-2.9) (griseus 2.9 / opistho 2.4)

Too short for P. diatomicus (50-54 mm tarsal length)

Probably in range of P. kanakoffi for length, but with stouter shaft, Stouter also than Laguna Hills bones or P. diat.

3.9 gr. depth sh ext prox br. (Laguna Hills 4.~~3~~ 4.5 P. calhouni 4.2 griseus, 3.5 opistho)

Check this

Hypotarsus: ~~internal~~ calcaneal ridge on line with ~~int.~~ edge of shaft as in P. opisthomelas + fossil P. kanakoffi, (ridge is inset in P. calhouni + P. felthami, + P. diatomicus).

Proximal cotylae evenly flared resembling P. calhouni in this respect as distinguished from P. diatomicus (especially internal side, which in P. diat. flares inward + prox'ly

Cedros does not have as marked an anterior development of the ext. side of the shaft as in P. calhouni, P. felthami or P. kanakoffi.

Compared to P. opistho - shorter but much heavier

If we had only the prox. half # 15386 we would assume the whole element to exceed opistho in all dimensions (the shaft br even exceeds that of P. griseus (3.0 in middle, griseus 2.9 in middle) length bet foramina in P opistho 34.4, 41.6 in griseus (32.8 in Cedros) br sh. middle in opistho 2.4 (3.0 Cedros), Prox br cotylae opistho 6.4 (Cedros 6.8, griseus 8.2) griseus flares intercotylar

Prox br. measured coming down from prox end with bar of calipers at right angles ~~[illegible]~~ to axis of shaft + above prox end,

а б ~~вв~~ ьвв.

абвгдежзиклмнопрстуф

а б в г д е ж з и к л м н о п р с т у

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сп спо с сп сп спа спат

Puffinus sp. cont'd p. 2 Cedros Id

Humerus Broken so br. dist end impossible to ascertain

Depth ext. condyle – 7.6, griseus 8.1, opistho 6.4

br/depth sh unworn'g above ectepi proc.	4.5/8.3	.. 4.7/8.3	" 3.7/6.4
longest (diag.) diam. of brachial impression	5.7	.. 5.3	" 5.0

Lower end brachial impression cuts in mediad of int. lig. attachment as in opistho

Ectepicondylar process lacking but extent of broken area suggests its top margin was 11 mm above distal contour of ext. condyle. (10.0 opistho, 11.5 griseus)

Distal end of tibiotarsus

br. condyle	7.3 (griseus 7.2,	opistho 5.9)	
depth ext condyle	7.1	" 7.0	.. 5.8
br sh	4.9	.. 4.6	.. 3.7

Puffinus n. sp.

~~Holotype~~: Prox end tarsometatarsus 15386

Paratype: Inc. tarsometatarsus 15387

Locality: SDCM loc 65151;

Formation & Age Salada formation early Pliocene

~~Diagnosis: Tarsometatarsus similar to P. opistho in length of int calc ridge & continues with shaft edge~~ but shorter & stockier than ~~P. opisthomelas~~, & ~~prox cotylae more evenly~~ flared

Diagnosis: Resembling P. opisthomelas in the margins of the internal calcaneal ridge ~~margin~~ with the internal edge of shaft posteriorly, but bone shorter & stockier than in P. opistho, prox end more evenly flared & margins of ~~cotylae~~ less proxly extended

~~Tentative~~ Referred material: Complete ulna 15404, distal frag. humerus 15403 both from loc 65153, and distal half tibiotars 15378 from 65151

Oct. 4, 1930 Cedros Id. Puffinus compared to other species

Humerus	Cedros 15409	El Toro P. calhouni type 17508	P. pisenus type	Shufeldt Heller ref 17502	P. mitchelli type	ref. 17600 max	P. kanakoffi cotype 2120	ref 2160	Kanakoffi P. santiago ref 2116	2114.	✓ P. inaptus Type	P. conradi	✓ P. felthami type		P. diatomicus type		✓ Tepus quiet specimen		1 opistho Bi 554	gris Bi 50
Br dist condyle	—	7.1	7.3 —	7.4	8.4+	9.1	7.3	7.6	8.0.	7.7	8.75	9.2	8.5		7.1			51	7.7	9.3
Depth ext. cond.	7.6	6.5	6.6	6.9	7.3	8.4	6.1	6.3	?	?	7.5		7.3		?				6.4	8.1
Ht ect epic	11.0?	9.3	9.8	9.9?	10.9	11.4	8.9	9.6	9.8	8.5	10.3	12.5	11.0		11.5		10.0		10.0	11.5
Br shaft	4.5	3.0	3.2	3.4	3.9	4.0	3.1	3.3	2.7?	3.2	4.5	5.0	3.7		?				3.7	4.7
just above ect epi Depth sh	8.3	6.0	6.2	6.5	6.9	7.0	5.9	6.1	5.4	5.6	5.9	7.8	7.1		6.8				6.4	8.3
Length															Type 75.0 —	84.0	86.8		84.4	104.6
Ulna	Cedros 15404	calhouni 17544	calhouni 17530				P. kanakoffi													
Length	86.75						75.7								71.0 —	79.0	85.7	quiet sm 102.6	554 77 | 51 75.0	#50 96.7
Prox condyle Breadth	8.1	6.3	6.6															8.8	7.2 | 6.8	8.7
Depth thru olecranon	9.2	7.7	7.7															9.7	8.5 | 8.0	9.6
Length brach. imp	15.2																	13.8	13.2 | 13.2	13.5
ap br brach imp	2.2																	2.0	1.9 | 2.0	2.2
Depth dist ext	6.9																	7.4	5.7 | 5.7	7.5
Sh below middle br/depth	4.1/4.8		3.8/4.3															4.1/5.5	3.6/4.5 | 3.4/4.3	4.2/5.3
Tarsus	Cedros 15367	Cedros 15386	calhouni 17582		kanakoffi 2572	2114	→ Type 2122	Type	P. felthami cotype						P. diat. ap. length					
Length bet foramina	~~32.3~~	—	?						?						71–	79		51 #554 35.2 34	33.3	41.0
Shaft mid br. breadth	3.0	3.2	3.0		2.6?	2.7?	2.6?		2.8									2.4	2.6-3.2	3.4
sh ap. depth ext	3.9	4.0	4.4?		3.7	3.5	3.9		4.3									3.7	3.3-3.9	4.4
Br. Prox	—	6.8	6.65	6.6	6.45	7.1	6.5		7.5									4.5	5.9-6.9	8.0
Tibia br. dist mid	Cedros 15370 7.3	X																	5.9	7.2
Depth ext condyle br sh	7.1 4.9	X																	5.8 3.7	7.0 4.4

Cedroensis
beats from
loc. 65153
LACM# 15390

TABLE V

Size Range (in millimeters) of *Mancalla cedroensis*

and Measurements of Type Elements

	Max.	Mean	Min.	No. individuals measured	Type
CORACOID					
Length	47.5	45.3	43.2	3	43.2
Breadth below furcular facet	6.0	5.3	5.2	3	5.3
HUMERUS					
Length	80.0	73.5	69.5	5	72.4
Breadth of proximal end	20.1	17.9	17.0		17.0
ULNA					
Length	31.7	30.0	28.3	12	29.5
Breadth proximal end	7.2	6.6	6.2		6.5
RADIUS					
Length	31.8	29.3	27.3	4	28.1
Greatest depth of shaft	6.1	5.6	5.4		
CARPOMETACARPUS					
Length	36.0	35.4	34.9	4	35.0
Depth proximal end through M1	11.1	10.5	10.2		broken
FEMUR					
Length	56.5	55.4	54.7	3	54.7
Breadth of distal end	10.8	10.6	10.4		10.6
TIBIOTARSUS					
Length	....	83.9	....	1	83.9
Breadth distal end distal end	9.5	9.2	9.0	4	9.4
TARSOMETATARSUS					
Length	42.0	39.2	37.3	3	...
Breadth of proximal end	10.9	10.3	9.9	?	10.2

Table IV

	M. diegense	M. cedrosensis	M. milleri
CORACOID			
Furcular facet (viewed internally)	Anterior edge projected anteriorly; tip raised slightly and gradually	as in M. diegense	Anterior edge nearly on line with anterior contour of trios seal canal; tip upswept anteriorly with abruptly raised, high, pointed tip.
HUMERUS			
Internal contour from shaft to bicipital crest (viewed anconally)	Almost a right angle, with ligamental attachment at base of bicipital crest prominent, adding to the effect of angularity and	Broad, gradual curve; ligamental attachment well developed but less distally projected than in M. diegense	similar to M. diegense, but slightly less angular
☆ Area ~~for attachment of~~ of origin of external head of triceps muscle (below head anconally)	Of generally angular contour at junction of head & pectoral crest Relatively broad and	Narrowly oval in contour and deeply depressed	As in M. diegense
FEMUR			
Obturator ridge	Relatively short with generally rounded contour. depression if present is faint.	Relatively short with distinct depression on internal side	Relatively long with angular contour sharply defined by deep depression along internal edge
TIBIOTARSUS			
☆ Internal ligamental prominence (distally)	Indistinct, and placed at upper level of internal condyle	Prominent, rounded and papilla-like, situated below level of proximal edge of internal condyle	Indistinct; situsted below level of proximal edge of internal condyle.
☆ External ligamental prominence	Well developed	Negligible	Negligible
TARSOMETATARSUS			
Anterior view	Flaring proximally; external border of shaft sharper than internal; shaft moderately depressed proximally	Flaring proximally; borers of shaft sharply defined	Columnar in appearance; both borders of shaft sharply defined; centerlwell depressed even at level of muscle scars

Charoids

49.7
49.0
48.7
48.6
45.0
46.7

6)287.7
47.9

40.1
41.5
40.5
41.4
40.8
40.0
39.9
39.6
42.0
37.3

40.31

Distinctions Mancalla milleri, M. diegense, M. cedrosensis

Femora:

M. milleri: The only reliable qualitative char. of this element in milleri as distinguished from M. diegense is the very deep ~~[illegible]~~, ~~[illegible]~~ excavation ~~partly~~ on the internal side of the obturator ridge. All milleri are slender of shaft (least br sh less than 10% of length from neck to intercond. fossa

Type, 2185

M. diegense sh 10% or more of length, no deep excav int to obturator ridge,

M. cedrosensis. Size + breadth of M. diegense but with deep excav beside obturator ridge as in milleri

Tibiotarsus

milleri short + slender 72.5 – 76.9 dist br 7.2 – 7.5

17

~~[illegible]~~ 4.7 – 3.1 66 4 ✓ 5.5 – 4.0 73 6.1 – 4.3 67

4.9 – 3.7 3 ✓ 6.1 – 3.9 64

5.0 – 3.7 74 1 ✓ 6.5 – 4.6 71

1.7 2 ✓ 6.2 – 4.3 69

Dist. ~~crest of out~~ shallow ~~narrow~~ ? ~~antic facet prox-distal distance from [illegible] to [illegible] to lower edge of [illegible]~~ can't meas exactly.

Post. border of antic facet unnotched.

	of least	dist
2368	9.0	9.8
2125	8.9?	9.8?
3681	8.0	8.1
2628	7.4	7.4
2083	7.3	7.2
2579	7.5	7.7
Cedros	9.3	8.7

diegense. Post. border prox antic facet deeply notched between ext + int sides

bridge 82.2 8.6 Bridge 74.4 7.3

bridge 85.7 8.7 " 72.0 7.1

bridge 80.8 8.9 " — 7.6

bridge dist ~~[illegible]~~ 8.4 " — 7.5

" — 7.6

— 7.9

44[illegible]
453
443
437
441
420
433
430
447
413
4387
24 5835
10222

438.7
542.7
23)9814(42⁶⁄₂₃
92
61
46
154
138
16

437
436
41[illegible]
421
432
418
413
~~40.8~~
432
427
424
387
395
402 ✓
5835
~~4~~408
5427

71
[illegible]
65
68
68
70
70

64
62
65

62 57
57
56

57.0
537
520
528
497
41[illegible]
46[illegible]
487
8)4073
51.0

✓
✓

81.3 cora ✓
87 ulna ✓
81.5 scap
84 tarsus ✓
82.2 tibia ✓
88.3 carpus ✓
79.4 radius ✓

Distinction M. milleri; diegensis, cedrosensis

Aug. 5, 1969

Tarsometatarsus

	length	sh	%	dist	%	% sh/dist	prox	% sh/prox
2678	43.6 ×	5.4	12.3	10.0	22.8	54.0	10.6	51.0
2327	36.1	4.4	12.1	7.9	21.9	55.7	8.1	55.0
2548	32.3	4.4	13.6	7.4	22.9	59.5	8.3	53.0
2682	31.2	3.9	12.5	7.3	23.4	53.5	~~[illegible]~~	~~[illegible]~~
cedros 1234	38.3	4.9	12.8	9.0	23.5	54.5	9.5?+	51.5

} not significant

but milleri taxa 2327 few — 1075 (2682 small M ?)

M. milleri: ~~Borders~~ Ant. surface of shaft ~~anteriorly~~ markedly depressed with ext & int borders sharply defined, ~~with markedly depressed~~ giving a columnar appearance to the shaft. muscle attachments deeply inset from shaft borders; ext cotyla narrow ~~as it connects with prox end of ridge bordering ext. edge of shaft.~~ ~~Proximally~~ Distally, int. condyle blunt in post. contour, slight longit. depression or groove above condyles ~~on ant surf of shaft~~ posterointernally.

M. diegensis: ~~Ant. surface~~ of Shaft less columnar in appearance with less sharp bordering ridges anteriorly, int. ridge lower and muscle scars less deeply inset. Int. condyle moderately pointed & upturned in int. contour, & slightly flared laterally Shaft above condyle smoothly convex

M. cedrosensis: Shaft ~~[illegible]~~ only moderately depressed anteriorly, bordering ridges ~~[illegible]~~ int ridge lower more round than sharp; muscle scars prominent & less inset even than in diegensis. Int. condyle ptd & upturned & flared as in diegensis; shaft above condyle convex but with slight longit depression toward post. ~~edge of~~ junction with condyle

Coracoid

M. milleri: Short, slender bone with high narrow pt ~~on~~ at tip of furcular facet. Ht at tip 80-90% of br of facet & 100% of br below facet. thru trios. Max ant post depth thru trios. canal 80-84% of lateral dimension thru trios

M. diegensis; Long, rel. slender bone with lower, blunter tip of furcular facet (62-71% of br of facet, 87-97% of br below facet) depth rel. to br. thru trios 72-75%

M. cedrosensis; Of medium length but stockier than either of the other 2 & rel. shorter from glenoid facet to tip of furc. facet. furcular facet overhangs triosseal canal more markedly than in diegensis - espec noticeable in ant view ~~the facet [illegible]~~ Depth rel. to br. trios 90-92%

thicker ant post dimension thru trios canal at narrowest pt & 90-92% of lgth, 72-76 in diegensis 81-84 milleri *

Ulna - I can detect only size difference between M. milleri & M diegensis

M. cedrosensis appears to have more prominent olecranon than the others - either longer ~~more slender~~ or more pointed or with deeper depression internally

* M. milleri possibly has deeper int. depression on olecranon than diegensis

Tip of olecranon is broken in many milleri

No differences in scapula (other than size)

	bz a	Below [illegible] sh of cran. depth	X	ratio ~~ba~~	ax	bx	pr. V. dur lower ext	yx
15410	5.4	4.9	45.0	92.5	12	10.9	34.5	76.6
15320	5.4	4.8	43.4	90.8	12.4	11.0	31.8	73.6
2310	5.9	4.3	45.6	72.8	12.1	8.8	38.9	73.9
45863	6.0	4.7	48.7	78.3	12.3	9.4	35.7	73.0
2067	5.0	4.2	50.1	84.1	9.9	8.4	37.2	74.2
2422	5.2	4.6	48.1	85.5	10.8	9.5	35.9	74.5
46028	4.9	4.1	43.5	83.9	11.2	9.4	32.2	74.0
2559	4.4	4.0	40.7	91.0	10.8	9.8	29.6	72.7
2229	4.5	3.9	40.4	89.0	11.1	9.6	30.3	75.1

Means	diegu	cedros	millers	15373
Tar/tib	44.5	46.4	45.4	46.3 or 46.9
fem/tib	61.3	66.0*	64.0	65.5* ok
cor/hum	64.5	61.4*	63.5	60.0* ok
ulna/hum	38.2	40.7	40.4	40.9* ok
rad /"	38.2	39.8	39.6	39.6
ulna/carp	82.1	84.9	80.3	83.0
~~ulna~~/cora	59.6	65.4	63.2	68.0
cor/tib	54.5	54.0	53.6	51.5
ulna/rad	100.0	102.2	103.0	105
~~fem~~/tars.	72.2	71.0	71.0	71-72?
hum/tib	84.6		84.0	86.0
tars femur (intedect)	75	~~?~~		72.6
carp/cora	72.7	78.3	78.8	82.6
carp/hum	46.9	48.3	50.3	49.6
fem/hum	72.3	75.3	76.0	75.6%

tib 83.9 fem 54.6

short cora. cedros

hum 72.1 cora. 43.2
ok ulna 29.5 rad 28.0 or

tarsus est 35.8 or 39.3 based on femur

#1284 cedros femur 36. tars. 38.3
68.5

shorter tibia

Aug 27, 1969

15373
carp 35.8

77.5 ≥90 45.0 cora. 15410
35.0 carp? diam

Uria aalge #477

	min	mean	#15373	min	mean	max	Uria aalge #477
cor/hum	67.0	64.5	59.5	68.3	63.8	65.0	57-
cor/ulna	170	167.5	146.0	167	158	163.2	58.5
" / femur	88.3	89.4	78.8	86	83.7	85	76.8
" / tib	58.7	54.6	51.5	53	53.5	56	56.5
" / tarsus	124	123	112. ?est	124	117.6	120	94.5
" / carpus	135.5	138-	120.1	130	126.8	131	

cor 37.3
hum 83.6
ulna 63.9
femur 48.6
tib 86.0
tars. 39.5

15373 mean	
cor Ced/cor deg	87.5 90
hum " hum "	94.5
ulna	100 90
carp	100 90.
femur	99.1
tib	93
tars.	97.5 est

cor uria / cor ~~diegues~~ millers mean	mean	millers max	min
cor uria / cor	93.2	86	97
hum "	104.5	98.5	102.0
ulna	252.0	240	
femur	101.5	95.0	108
tib	88.3	85.3	91
tars	116	109.	

cora of uria smaller than min

hum within range ✓

ulna much longer

femur within range ✓

tib smaller than min

tarsus larger than max
(= mean of diegues)

TABLE III

Size Range and Variability in Length of Limb Elements of

M. diegense, M. cedrosensis, and M. milleri

Element and species	Number of specimens	Length (in mm) Max.	Mean	Min.	Ratio of maximum to min. (%)	Coefficient of variability (V)
CORACOID						
M. diegense	8	54.0	49.4	47.5	113	4.8
M. cedrosensis	3	47.5	45.3	43.4	109	4.4
M. milleri	7	43.5	40.0	38.5	112	3.4
HUMERUS						
M. diegense	7	85.2	76.5	71.0	120	6.6
M. cedrosensis	~~9~~ 5	80.0 25	73.05	~~72.5~~ ~~70~~ 69.25	~~117~~	~~4.6~~
M. milleri	23	66.6	62.7	56.4	112	4.0
ULNA						
M. diegense	4	32.1	29.4	28.0	114	6.3
M. cedrosensis	12	31.7	30.0	28.3	112	4.4
M. milleri	14	26.6	25.3	23.1	115	4.1
RADIUS						
M. diegense	4	31.8	29.4	27.8	114	5.6
M. cedrosensis	4	31.1	29.3	27.3	114	6.6
M. milleri	4	25.2	24.6	24.2	104	5.1
CARPOMETACARPUS						
M. diegense	5	37.2	35.8	35.0	106	2.2
M. cedrosensis	4	36.0	35.4	35.0	103	1.4
M. milleri	7	33.2	31.6	29.6	111	4.0
FEMUR						
M. diegense	4	57.0	55.2	53.8	106	2.5
M. cedrosensis	3	56.5	55.4	54.8	102	1.6
M. milleri	10	51.1	47.9	44.9	114	4.2
TIBIOTARSUS						
M. diegense	7	98.5	90.2	80.8	121	6.8 4
M. cedrosensis	~~7~~ 1		83,9			
M. milleri	7	77.5	74.9	72.5	107	2.6
TARSOMETATARSUS						
M. diegense	4	43.7	39.9	37.7	116	6.8
M. cedrosensis	3	42.0	39.2	37.3	112	6.3
M. milleri	5	36.1	34.0	31.1	116	6.3

TABLE IV

Qualitative Characters

Distinguishing *Mancalla diegense* and *M. milleri*

	M. diegense	*M. milleri*
CORACOID		
Furcular facet (viewed internally)	Anterior edge projected anteriorly; tip raised slightly and gradually	Anterior edge nearly on line with anterior contour of triosseal canal; tip upswept anteriorly with abruptly raised, high, pointed tip.
HUMERUS		
Internal contour from shaft to bicipital crest (viewed anconally)	Almost a right angle, with prominent ligamental attachment at base of bicipital crest adding to the effect of angularity	S~~imilar to M. diegense~~ th~~ough possibly~~ less angular. than in M diegense & lig attach less projected.
FEMUR		
Obturator ridge	Relatively short, with generally rounded contour; very slight depression internal to ridge.	Relatively long, with angular contour sharply defined by deep depression along internal edge of ridge.
TIBIOTARSUS		
Internal ligamental prominence (distal end)	~~Indistinct, and placed~~ situated at upper level of internal condyle	~~Indistinct, and~~ situated below level of proximal edge of internal condyle.
External ligamental prominence	Well developed	Negligible. (B2117 like this)
TARSOMETATARSUS		
Anterior view	Flaring proximally; external border of shaft sharper than internal; shaft moderately depressed. B21176 like this	Columnar in appearance; both borders of shaft sharply defined; shaft well depressed.
ULNA	Olecranon blunt, and straight with respect to shaft contour (in lateral view); very faint depression int to olecranon	Olecranon as in M. diegense but internal depression deeper
Tibiotarsus Posterior contour ~~[illegible]~~ articular surface	Deep notch separating ext & int ~~portions~~ of the surface	Slight indentation but the two areas not deeply separated

Distinctions

Cedros ~~from~~ vs S.D.

	Cedros			S.D		
	15373	15416	15400	2310	2067	2229
Coracoid stockier length inside tip	43.4	45.0	—	48.4	50.2	40.4
br sh below procoracoid	5.3	~~5.6~~	5.3	5.6	5.0	4.6
depth sh "	4.9	5.4	5.0	4.5	4.8	4.0
back of tip { br head narrowest pt	3.7	4.0	—	4.1	4.3	
length from fure facet to edge of glenoid	5.6	6.3	—	7.5	8.2	
gr Depth across thru glenoid	7.1	7.1	7.2	6.9	6.9	5.5
Ht below scap facet & head	16.3	17.2	—	12.6	17.9 ~~16.2~~	13.7 OK
Br fure. facet	7.0	7.3	—	8.0	8.5	5.5
Br below facet	5.1	5.9	—	5.9	6.1	4.7
Ht fure tip	5.3	6.2 ok	—	5.5	5.3	5.5?
length to center sternal facet	45.0	47.1	?	50.2	51.7	41.5

See Mancalla Mt //

Scap 15373 br 12.4 15410 13.5 13.7
br sh 6.4 6.9
depth sh 3.1 3.0

Femur 15373 length infucord 52.1 1284 L 52.0 R 52.8
sh br 5.0 4.6 4.6
" depth 6.15 5.8 5.7
11.0 x 10 br depth dist

Tibia only 2880 S.D same length & dimensions as 15323
length Cedros 83.8 S.D 82.3+ (eroded) br. tibia dist 9.4 (# 1284)
tarsus 38.3
sh { br 6.1 6.2
depth 4.3 4.0
br dist 9.2 no bridge 8.9+ (bridge)

Note S.D # 2681 one would be longer than 15373 to judge from fibular crest but it is slimmer 5.5 x 4.2 br dist 8.2# (bridge)

Carpometacarpus of Cedros int. crest of trochlea longer (comes down onto M3

Both crests more clearly marked than SD

~~Ulna Cedros int. scar long anconal-palmar dimension, short triangular prox dist~~

No good ~~prox dist~~ ~~S.D short " " long,~~

Cedros ulna may have long, sharper olecranon

53
54
53
3)162
5.4
cedros
51
59
2)110
5.5
S.D
5.0
5.9
6.1
3)170
5.6
62
53
2)115
5.7
S.D
~~ht~~ facet
5.6
5.4
5.5
3)165
5.5

Cedros
43.4
45.0
2)884
44.2 M
5.0
54.0
50.1
47.7
48.1
48.6
48.2
~~43.5~~
7)3402
48.6
40.4
40.7
39.2
39.6
39.3
39.6
39.3
40.2
8)3183
39.8
5.4
5.0
10.6

Radius

	Length groove	ratio length to ...	b gr length	b ratio y x	ratio groove to length %			t gr. Depth	sh. mid br	ratio tb	breadth below head y
UCMP 46016	8.7	8.9	31.4	83%	27.4	L	—	6.4	2.8	20.4	2.4
Loma 2812	8.0	~~7.8~~	31.8	~~88%~~	25.2	L	—	6.3 -	2.5	19.8	2.2
2484	9.6	8.8	29.6	9.2%	32.6	L	—	6.3	2.6	21.2	2.4
Cedros 15373	10.1	10.3	28.1	76%	36.0	Cedros		5.6	2.9	20.6	2.2
15369	9.4	9.9	27.2	77%	34.5	"		5.8	2.7	21.3	2.1
15416	8.6	7.4	29.8	8.6%	28.8	"		5.4	2.2	18.7	1.9
UCLA 2270	9.7	8.2	26.9	91%	36.0	S		3.5	2.2	20.4	2.0
V5519 Acc1067 2579	12.7	7.7	24.1 29.8	113%	42.5	calif.		7.1	2.3	23.8 L	2.0

M. calif. radius: deep groove along lateral edge extending nearly half way up the shaft (42.5% of length). Shaft thin but deep; below head lacks indentation found in the other sps. (br below head greater than br midsh.

Lower, cedros vs S.D

	length	a ulterior length 4,5 depth neck	ab	b 8.6 depth troch. to ofteunulles	bc	c ~~10.5 ...~~ br prox	x shaft y depth	ac
Cedros 1284 R	~~52.4~~		52% ✓		81%		4.6 - 5.7	42.5 C
" L	52.1					10.6	4.6×5.7	
Loma 2681	—	4.0	50?	8.0?	74%	10.3	4.9×5.0	38.8 L
2668	—	4.3	46	9.2	82%	11.1	4.9×5.7	38.8 L
Cedros 15373	52.2	5.1	55 ✓	9.2	88%	10.5	5.0×6.1	48.5 C
UCMP 2220	51.4	4.4	49.5	~~8.9~~ or		~~11.3~~ or		39.0 L
Cedros 15425	—	4.5	51 ✓	8.8	86	11.2	4.8×5.9	40.1 C
Topo 33494	53.1	5.0	54	9.1	82	11.1	4.5×5.0	45.0 L
2348	48.5	3.7		—		9.4	4.2×4.9	39.4 S
2270	?	3.5	47.3	7.4		8.6	4.0×4.8	40.6 S

Description of femur [illegible]

3 from SDSD
3 Lacm
2 UCLA
1 UCMP
} 9 complete

Size & proportions resembling Uria aalge californica

post depression above condyles deeper & better defined

Obturator ridge less protruded, with deeper depression int. to it (no depression in Uria)

Tibia length less than U. calif.

Tibia in cedros & milleri?, int surface of int condyle raised ~~into~~ dist contour separating surf into 2 depressions (in diegensis, small papilla at prox part so depression ~~is less~~ more wide spread ~~although~~ distal part doesn't hold in UCLA 2294)

coracoid T 15400 uc 1
5.4 br
5.1 depth } sh below procoracoid

Tibia int cnemial crest convex anteriorly in diegensis slightly concave in milleri

15a

TABLE IV

Estimated Size Range of Limb Elements of

M. diegense, *M. cedrosensis*, and *M. milleri*

add scapula m caciy!

Element	*M. diegense* Number of bones	*M. diegense* Length in mm	*M. cedrosensis* Number of bones	*M. cedrosensis* Length in mm	*M. milleri* Number of bones	*M. milleri* Length in mm
CORACOID						
Maximum	9	54.0	2	~~47.5~~ 5 u	9	43.5 11%
Mean ok	~~8~~	49.~~4~~1 13%	~~3~~	45.3	~~7~~	40.0 V=3.3
Minimum	113% V=4.8	47.5		43.~~3~~2 ok		~~38.5~~ 39.0
HUMERUS						
Maximum		85.2		80.0		66.6
Mean ok	7	76.5	5	73.5 72.4	2~~3~~5	62.7 118% 4.0 V
Minimum		~~71.6~~ 120% V=6.6		69.5		56.4
ULNA						
Maximum 28.6 6 32.1		32.~~0~~ stat		31.7		26.~~6~~7 stat ~~27.0~~
Mean	~~4~~ 6	29.~~4~~3 111.5%	12	30.0 29.5 12%	~~14~~ 13	25.~~3~~2 14
Minimum		28.~~0~~6		28.3		? ~~23.1~~ 23.6
RADIUS						
29.7 Maximum		31.8		[illegible] 31.1		~~25.2~~5 ~~26.9~~ 2 ... mont.
Mean	~~4~~ 3	29.4 17%	4	29.3 28.0 14%	~~4~~ 5	24.6 14
Minimum	stat	~~27.8~~ 27.0 ~~29.6~~ stat		27.3		24.2
CARPOMETACARPUS						
41.1 Maximum		37.2		36.0		33.2
Mean	~~5~~ 7	35.8 6%	4	35.4 35.8 3%	7 ok	31.6 12% 12
Minimum		35.0		~~35.0~~ 34.9		29.6
FEMUR						
Maximum		57.0		56.5		51.1 13%
Mean	~~4~~ 5	55.2 6%	3	55.4 54.6	~~10~~ 9	47.9 13
Minimum		53.8		54.8		~~44.9~~ 45.0
TIBIOTARSUS						
Maximum 91.4		98.5			11	82.0 77.5
Mean 5 93.5-M	~~7~~ 22	90.2 22%	1	83.9 ✓	~~7~~	76.5 74.9 7%
Minimum 98.5		~~80.8~~				72.0 72.5
TARSOMETATARSUS						
Maximum		43.4 43.7		43.0	~~7~~	38.3 ~~36.1~~ 14%
Mean	~~4~~	40.5 ~~39.9~~ 14%	3	39.2 13% 38.9	~~5~~	35.0 ~~34.0~~ 15
Minimum	✓	~~37.7~~		37.3	5	31.1 31.1

Nov 4 196

Order Pelecaniformes: Family Sulidae

Morus sp.

A distal end of a left humerus (LACM 15413) from Arroyo Delphin (LACM locality 65148) is crushed and broken in several important diagnostic areas. However, the long attachment of the anterior articular ligament and the positions of the attachments on the entepicondyle and ectepicondyle suggest alignment with *Morus* rather than *Sula*. The olecranal fossa, also, is seemingly less depressed than in *Sula*, although the broken borders of the fossa may create a false visual impression of the area.

One portion of the specimen, fortunately preserved, is the well developed entepicondylar area, which serves immediately to distinguish it from the type of *Sula humeralis* from the San Diego Pliocene. *S. humeralis* is similar in size to the Cedros Island bone but is described (Miller and Bowman, 1958:10) as being underdeveloped in the entepicondylar area. Size alone separates the Cedros bone from other westcoast Tertiary sulids, but it closely approximates in breadth a humerus from the Miocene of the eastcoast referred to *M. loxostyla* (Wetmore, 1926:467). The latter species, in turn, appears to equal the Pliocene *Sula guano* and *S. phosphata* (from Florida) based on the coracoid. Assignment of the imperfect Cedros bone is inadvisable.

Measurements: breadth of distal end, LACM 15413, 20.5 mm; *M. bassanus*, 23.9 mm, *S. dactylatra*, 20.9 mm, *M. loxostyla*, 21.1 mm, *S. humeralis*, 19.8 mm, *M. vagabundus*, 17.2-18.5 mm. Length of attachment of anterior articular ligament, LACM 15413, 9.8 mm (approx.); *M. bassanus*, 8.6 mm, *S. dactylatra*, 5.7 mm, *S. humeralis* (from illustration), 6.5 mm, *M. vagabundus*, 6.6-8.6 mm.

~~Lynx femur~~ Buteo femur from Stanton Cave
To Lynn Hargrave

~~Buteo borealis because of ant. position of muscle attachment~~
~~ant. lig. above condyles (B. regalis goes [illegible] & ext side)~~

	~~Lynx~~	~~536 B. bor.~~	~~reg. 948~~	~~ba 723~~	~~331~~	~~829~~
~~intercondylar to ant. & post. length~~	~~82.2~~	~~79.3~~	~~80.75~~	~~78.8~~	~~77.7~~	~~82.2~~
~~least sh. br.~~	~~7.4~~	~~6.6~~		~~7.2~~	~~7.2~~	~~7.8~~
~~prox br~~	~~15.43~~	~~14.5~~		~~14.9~~	~~15.2~~	~~16.5~~
~~dist width across cond~~	~~13.0~~	~~12.7~~		~~13.0~~	~~12.6~~	~~14.0~~
~~Ratio sh. br. & length~~	~~9.0%~~	~~8.3%~~		~~9.1%~~	~~9.2%~~	~~9.5%~~
~~Ratio br. prox & length~~	~~18.73~~	~~18.32~~		~~19.0~~	~~19.5~~	~~20.0~~
~~Ratio br. conds. & length~~	~~15.81~~	~~16.0~~		~~16.6~~	~~16.2~~	~~17.0~~

Cedros tarsus Pammyard

Large tarsus # $\frac{65148}{15423}$ has deeper middle trochlea

Aramus 'goose' depth 14.0, br. 8.8 ; B. cav. 10.~~5~~ x 8.2 ; Cheudyle 9.~~5~~/6.3

Depth ext cond 13.4, br 5.6 " 10.2 4.7 " 9.4/4.6

" int " 13.3-13.7 7.4-8.7 " 6.8-9.3

ht ext cond 12.1 9.2 " —?

ht int cond 13.1 9.9 " 9.3

Meas Paloelodus ambiguus Milne Edw p. 72 crassipes p. 78 gracilipes p. 78 goliath

B dist end 12.0 16.8 11 18.5

Cedros tarsus Pammyard

On the basis of the generic description of distal Trochlea for digit four in Megapaloelodus (∠ > 60° from inner & outer rim of trochlea relative to axis of shaft), the Cedros specimen with an ∠ of 42° is within the range specified for Paloelodus (NOT Megapaloelodus) see A. Miller 1944 p. 86. Trochlea for digit 2 raised higher above middle trochlea than M. connectens + terminates posteriorly in a ~~with~~ distinct, though blunt process, laterally deflected

Cedros tibia Pammyard

Tibia Paloelodidae rather than Phoenicopterid in rounded ridge in center of distal ant. surface and single papilla ext to bridge for attach. of ext. end of ligamentous bridge. Depression distally back of both condyles but best preserved (?) internally

Cedros Id., Shearwater (s?)

inc at both ends / prox half
Tarsometatarsi 65151/15387 and 15386

Distinguished from P. ~~kanakoffi~~ felthami and P. calhouni and P. priscus (ref. tentatively from S.I.H.) in having internal calcaneal ridge at same external level as external edge of shaft — as in all Recent forms (P. creatopus, P. griseus, P. opisthomelas, P. pacificus, P. gravis). Resembles only P. kanakoffi of fossils at hand (P. kanakoffi, P. felthami, P. calhouni, P. priscus ref.?)

#15386
depth cotylae 4.1
br. across " 6.8
~~length bet foramina 32.4~~

15386
least br sh 3.3
depth ext sh (gr) 4.0
depth int side sh 3.0

#15387
br sh 3.0
depth ext sh 3.9
depth int side sh 2.7

15387 length bet foramina 32.4

P. ~~kanakoffi~~ ~~2572~~

	Kanakoffi #2572	2176	Type Kanakoffi	pacificus 1358	felthami	opistho 557	Cedros # 15386	15387
br cotylae	6.4	— ?	6.5	7.5	7.3	6.8	6.8	—
least br. sh	2.5	— 2.4	2.7	2.9	2.8	2.35	3.2?	3.0
gr. depth ext sh	3.5	~ 3.5	3.8	3.3	4.25	3.5	4.0	3.95
depth sh int	3.0	— 3.0	2.8	2.2	3.4	2.6	2.75	2.7
length bet foramina	33.0	— ?	32.5	35.65	—	33.2	—	32.4
distance from foramen on int calcaneal ridge to top of calcaneum	3.9	3.7	3.7	4.0	4.7	3.7	4.6	—
depth cotylae								

In general a heavier bone than P. kanakoffi

Humerus & ulna prob. same sp.

Humerus 15403		type felthami	Kanakoffi 2316	2160	P. mitchelli 17600 SFH	P. priscus ref.	cast P. [illegible]
Shaft right above brachial impression br/depth	4.1 x 8.0	3.9/7.5	3.7/6.8	3.5/6.4	4.3/7.5 type cast 4.0/7.3	3.7/6.7 cast type 3.6/6.3	4.0/6.6
depth ext cond	7.6	7.8	~~depth~~ 6.7	— 6.4	8.2	7.06	

Brachial imp. more oval than felthami

depth = gravis but not comparable ~~[illegible]~~ 4.7/7.3

P. conradi type cast 5.3/8.3

Ulna 15404		Kanakoffi 2821
gr. length	86.7	75.7
br cotylas	7.8	7.3
depth prox	9.3	8.3

Brachial impression of ulna deeply incised adjacent to attachment ant. lig., much more so than in P. kanakoffi or P. opisthomelas, otherwise close to these 2 spp.

Proportions of prox end br/depth 8.6/9.3 (creatopus) 8.3/9.9 griseus 6.65/8.1 (opistho) 7.5/8.1 pacificus 8.8/9.7 gravis

Tibiotarsus 15378		creatopus ~~griseus~~ 662	griseus 577	opistho 557	pacificus 1358	gravis 18873
br dist end	7.3 ap.	7.75	6.9	5.5	6.2	8.0
depth ext cond.	7.3 ap.	7.35	7.35	5.5	6.35	7.7
br/depth sh	5.0/3.8	4.55/3.25	5.0/3.6	3.3/2.7	3.5/2.7	4.6/3.65

Kanakoffi tibia is incomplete (prox mem) but is obviously much smaller than the Cedros bone

Tibia is much too large for either tarsus

Indicates 2 species

Oct 7, 1970

Puffinus tarsus (Cedros) compared with

P. kanakoffi Int. calcaneal ridge long + merging with shaft as in P. kanakoffi
bone shorter + stockier. prox cotylae less prox'ly extended / less
cup-shaped

P. felthami Post'ly shaft flat mediad of int. calc. ridge, but in felthami it
is swollen + int calc ridge appears not to merge with the shaft
Tho. prox end is .5 mm narrower than felthami, the
shaft breadth is .6 mm greater; depth however is .3 mm less
Ant'ly ext edge of shaft at prox $\frac{1}{2}$ curves mediad as in
felthami

P. calhouni In P. calhouni the ext side of shaft ant'ly curves mediad even
more than in felthami + Cedros. P. calhouni differs
from Cedros in medial inset of internal calc. ridge.
Also slimmer. Area mediad of " " " swollen
in P. calhouni as in P. felthami

P. priscus? This swelling mediad of int calc. ridge also true of tentatively
referred P. priscus from Laguna Hill + again the int calc
ridge is inset from shaft.

P. sp.? Laguna Hills. Same remarks as for "P. priscus?" apply here
with regard to int calc ridge + adjacent shaft mediad

Puffinus humerus (Cedros) compared with

P. mitchelli Brachial impression narrower + presses further into lig. attach of int side than in mitchelli
Size about right. Lig. attach seems to end bluntly + flat in mitchelli as in Cedros

P. felthami Lig. attach. flatter + ends more bluntly proximad than in felthami.
felthami has convex attach. that curves to a pt. prox.

P. priscus Lig attach. seems like Cedros but brach impress does not
descend as far on it + undercut it as much (~~ditto mitchelli no descent of impress~~)

P. kanakoffi not like Cedros in rel. position of brach imp + lig attach.
+ shape of lig. attach. Small size differs

Ulna Cedros compared with

Sharktooth sp? 17505 — Brachial impression undercuts lig. attach deeply but not so in 17505 where brach impress very shallow

mitchelli? — Lig. attach long oval (but in 17505) which undercuts ~~int~~ cotylar area.

Sharktooth sp? 17503 priscus? — like 17505 (but much smaller) in shape & development of brachial impress. & shape of lig. attach. Also both have papilla below ext cotyla (a clear papilla in 17505, in 17503, more an extended area of cotyla

P. kanakoffi – Shape of lig. attach. closer to Cedros than in the other two but brach. impress. not so depressed as Cedros tho more depressed than Sharktooth Hills

P. cahooni 17530 & 17532 — lig. attach teardrop shape. Brach impress starts below (not beside it) & is not ~~[illegible]~~ depressed

Cedros lig. attach on ulna & brach impress relationship ~~to~~ it most like opisthomelas creatopus (of living forms) mitchelli(?) like priscus, Proportions of prox end (cl. to depth as in opistho. (narrower & deeper than creatopus

35.1	46.7	34.8	2.3
34.3	45.7	34.0	24
34.6	46.1	34.4	22
33.0	44.0	32.8	22
32.2	42.8	31.9	23
34.4	45.8	34.2	22
33.3	44.4	33.0	22
34.3	45.7	34.0	21
35.1	46.7	34.8	23
34.2	45.6	34.0	23
34.4	46.1	34.4	23
34.6	46.	34.4	25
34.4	47.2	35.1	22

13) 44 (34.1
34
55
52
35

13) 5930 (45.61 (37.3
52
73
65
80
78
2

13) 441.8 (33.9
39
51
39
128
117
110
34.0

13) 293 (22.5
26
35
26
90

14
3
52
7

13
3
39

August 30, 1970

Previously recorded Shearwaters and Fulmars from California

MIDDLE MIOCENE -- Sharktooth Hill HH1966

1 Puffinus inceptor Wetmore - distal end of humerus (ref? prox part shaft)
Large 2 Puffinus mitchelli L.Miller - distal end of humerus
3 Puffinus priscus L.Miller - distal end of humerus(another assigned and
2 humeral shafts? HH 1966) see below Lag. Hills

LATE MIOCENE

Lompoc, Sherman Oaks, Lomita, San Pedro, Capistrano Beach?
4 Puffinus diatomicus -- skeletal impressions
Laguna Hills
5 Puffinus calhouni Howard - distal end humerus (referred 2nd dist.humerus,
prox. ulna, prox tarsus; tentatively
incomplete dist. humerus,2 frag tarsal
shafts with portion of hypotarsus)
Puffinus priscus? frag distal end humerus; incomplete prox. part ulnar
shaft; proximal end tarsometatarsus
6 Puffinus sp. large prox end tarsometatarsus and large distal end of
tarsometatarsus
Fulmarus hammeri - left carpometacarpus (prox. end); referred distal
fragment of humerus (possibly younger than others)

PLIOCENE

7 SanDiego - Puffinus kanakoffi Howard - tarsometatarsus (humeri, ulna
also available)
Large 8 Corona del Mar - Puffinus felthami Howard -- distal end humerus type (prox.
end of tarsometatarsus also available),

386 35.2 210-99.8 102.7 83/80

	ratio length tarsus to length ulna	ratio br prox end to length ulna	rat. br to depth prox ulna	ratio br prox tars to br ulna	rat. br sh tars to br sh ulna
✓ P. kanakoffi	43%	9.2		94.0	71.5
✓ P. opistho	44%	8.9	83.5	90.0	68.7
	46.5%	8.9	86.5	95.0	66.7
P. p. cuneatus	33.6%			97.5	74.6
Pterodroma	27.1			97.0	
✓ P. griseus	41.5	9.3%	89.5	96.5	67.5
	43.0	8.6%	91.7	96.5	71.5
P. creatopus	35.5				
P. gravis	36.5			101.0	82.%
X P. tedfordi	37.2	9.1%	88.0%	86.0	70%

Tentatively referred; the ulna, 15404 from loc 65153

270% 230 gm This specimen is longer relative to the tarsal length than in P. opisthomelas but is within the range of rel. lengths of ulna to tarsus to be found within the genus. The prox end is narrow rel to its depth as in P. opistho & P. griseus; brachial impression is long & deeply depressed adjacent to lig. attach.; ~~br [illegible]~~ Length (~~tentative, small portion of shaft may be missing~~) 86.8 mm, ~~[illegible]~~ br prox cotylae 8.1, depth from palmar borders of cotylae through olecranon 9.1 mm, br. sh at middle 4.1 mm, depth ext cond of trochlea 6.9 mm.

~~Ratio br proximal~~	Ratio br prox tars to depth ext cond humerus
P. opistho	100%
P. tedfordi	88%
P. griseus	95% 93.5
P. p cuneatus	107%
P creatopus	100+
Pterodroma	87

Puffinus sp

A distal ~~end~~ frag of humerus and nearly complete ulna from LACM loc. 65153 ~~and a distal half of tibiotarsus from [illegible]~~ appear to represent a ~~larger species~~ of shearwater ~~than [illegible] P. tedfordi close in size to P. felthami & P. mitchelli & therefore larger~~ than P. tedfordi. ~~The humerus is very fragmentary.~~ The humerus ~~does not~~ It ~~appears to~~ resembles P. kanakoffi in the general shape of the brachial impression & its position closely appressed, almost undercutting, the lig. attachment, but the few measurements ~~dimensions of br & depth~~ that can be taken are all greater. ~~of shaft, depth of ext condyle, ht of ectepicond. process above the distal end are all greater than in the P. kanakoffi~~ The ulna has been pieced together ~~from [illegible]~~ and with the possible exception of one area appears complete. Length as repaired measures 86.8 mm. which considering its prox ~~depth of 9.9 mm~~ depth of 9.0 mm & br. of sh of 4.3 mm. is very short

An incomplete ulna apparently represents a species distinct from P. tedfordi. Its length ~~is at least 10 mm~~ exceeds ~~by at least 10 mm~~ the size ~~specimen~~ ulna of P. kanakoffi from the San Diego Plio. which I believe to be comparable to ~~by at least 10 mm~~. The specimen has been ~~re~~ mended & there is a question ~~with regard~~ ~~at~~ to one ~~area~~ contact point; possibly a section of shaft is missing, but as prepared the bone measures 86.8 mm. Breadth & depth of prox end ~~at~~ measure 7.9 & 9.0 mm. respectively ~~&~~ depth of ext crest of dist tuberc, ~~at~~ 6.9 mm. & br of mid of sh 4.3 mm. Each of these dimensions as well as the tentative length is 13-14 % greater than in the P. kanakoffi ulna.

Notes re:
Puffinus tedfordi

Puffinus humerus	shaft depth	shaft br	depth ext cond.	ect epi proc
Cedros	8.0	4.5	7.6	11.3 (scar
P. felthami type 2007	7.6	4.0	7.4 ~~[illegible]~~	11.3

Tarsus int. ridge of shaft caud'l more pronounced than in P. felthami, more like P. kanakoffi but shaft stouter than kanakoffi + int side of shaft visible from ant. view.

```
        .78
  32.)25.0
      224
       260
  32
  25
  ~~.7~~
       128
  25)320
     25
      70
      50
      200
```

⑤

Tarsometatarsus 15387 Cedros sh Puffinus

P. kanakoffi Type	ext cot to foramen length	dist foramen Br through	least br sh	gr depth sh	~~Br prox below flare~~	~~gr depth~~	br prox
P. kanakoffi Type	36.4	4.0	2.8	3.8			6.7
P. kanakoffi 2 max	37.3(2)	4.3 – 4.1	2.8(2)	3.4 – 3.6		~~3.7~~ – 3.6	6.9 – 6.8
Cedros 15387	36.5	4.8	3.0	3.9	has promin ~~ext~~ inert cotyla ant'ly		
P. felthami	—		2.8	4.2	~~6.8~~		7.2

Too short for P. diatomicus — Heavier shaft than P. kanakoffi

~~15388~~ also too stocky for felthami although depth is closer than to kanakoffi

15386	—		3.3	3.95	—		6.9
15387			3.0	3.90			—

Cedros tarsi have strong crest especi'ly on external edge of shaft near prox end (curving over medially as in P. felthami)

Humerus (prox) $\frac{65148}{15420}$ and $\frac{65151}{15408}$ could belong to the same small alcid. (smaller than San Diego humerus 2324 & differing further in having very undercut head

Prox ulna $\frac{65153}{15406}$ is near in size to San Diego ulna 2573 but has less developed olecranon and internal cotyla is larger depth int. cotyla to olecranon 5.6, depth cotyla 3.9 x 3.3

S.D. bone " " 5.7 " " 3.7 x 2.7

AVIAN SPECIES FROM THE MARINE PLIOCENE OF THE WEST COAST

✓ Podiceps
Colymbus parvus, S.D.?
✓ Colymbus subparvus, S.D.
✓ Gavia concinna, S.D. and M.
✓ Gavia howardae, S.D.
✓ Puffinus kanakoffi, S.D.
Puffinus felthami, C.D.
Puffinus tedfordi, C.
✓ Phalacrocorax kennelli, S.D.
✓ Miosula recentior, S.D.
✓ Sula humeralis, S.D.
Megapaloelodus opsigonus?, C.
Brachyramphus pliocenus, S.D.
Ptychoramphus tenuis, S.D.
Cerorhinca minor, C.
Mancalla californiensis, L.A. and C.M.
Mancalla diegense, S.D., H, and L.H.
Mancalla milleri, S.D.
Mancalla cedrosensis, C.
Letusa stirtoni, S.D.

Megapaloelodus opsigonus, C.
✓ Brachyramphus pliocenus, S.D.
✓ Ptychoramphus tenuis, S.D.
Cerorhinca minor, C.
Mancalla californiensis, L.A. and CM
✓ Mancalla diegense, SD, H and LH
Mancalla cedrosensis, C.
✓ Letusa stirtoni, S.D.
✓ Mancalla milleri SD

Four other west coast marine Pliocene localities have yielded one avian species each: Mancalla californiensis is recorded from the Third Street Tunnel locality, Los Angeles, and Mancalla diegense from Humboldt County (age at this locality is not confirmed) and Laguna Hills, Orange County

Single

¾ Four other west coast marine Pliocene localities have yielded

A single species is recorded from each of the other four west coast marine pliocene localities (all in California): Mancalla californiensis from the Third Stree Tunnel, Los Angeles, and Mancalla diegense from Humboldt County (age at this locality is not confiremd), and Laguna Hills; Gavia concinna is the one record from a Monterey County locality.

The early Pliocene fauna from Juntura, Oregon (including fish, reptile, bird and mammal) indicates a pond, lake or river community, not marine (Shotewell, 1963:15). Megapaloelodus opsigonus, in this fauna, ~~does~~ appears to be represented at Cedros Island. Other Juntura birds include cormorant, goose, dueks and coot.

The addition of the Cedros avifauna to the fossil record brings to 19 the number of specifically assigned avian forms knwon from the marine Pliocene of the west coast.

Cedar Id.

Sept. 5, 1970

Megapalaeolodus (?)

Measurements of Recent + other fossil Phoenicopterids

		antiquorum Cedar = roseus	ruber	chilensis	M. connectens	M. opsigonus	Goliath
Tarsus							
Br. prox		18.1-18.7	15.5-17.6	14.3-16.8	—	19.6	
Br. dist.	trans. 19.8 20.4 (diag)	19-22	18-20	19-20	21.3 (transverse) 22.7 (diag)	—	18.5
Tibia							
Br. distal	(18-19?)	16-18 [16.5-16.4]	13-16 [13.3-15.5]	15-16 (14.2-15.4)	17.0	—	
Depth distal		18-20 [17.8-19.67	17-19 (17.5-19.4)	17-18 (15.7-17.5)	18.8	—	

A distal end of tarsometatarsus #65348/15423 (no. not yet on specimen) and a distal frag of ~~tibio~~tarsus 65148/15422 represent a large flamingo of the family Palaelodidae.

Tarsus 19.8 mm in transverse ~~br~~ axis of trochlea, 20.4 mm diag'ly from outer rim of int condyle [not of deflected post. tip] to outer rim of external condyle. The angle of the line from int to ext. rim of outer condyle is 42° Thus falling into Palaelodus rather than Megapalaelodus as defined by Miller.

It differs further from M. connectens in more elevated internal trochlea with more prominent raised, blunt posterior tip which is slightly deflected externally.

The tibial fragment shows only the following characters which place it in the Palaelodidae: low rounded median ridge in intercondylar surface, attachment for ext. end of ligamentous bridge a single papilla above the external condyle; depressions in intercondylar area posterior to each condyle (but obscured internally; external portion of bone broken). The tibia seems to represent a slightly larger individual than the tarsus (if we may use living Phoenicopterus as a guide.

Over

References needed to complete

M. ~~[illegible]~~ opsigonus

Brodkorb Sula Oregon paper Jour Fla Acad Sci 1961 vol 24 p 173

Phoenicopterus measurements { HH Mani paper 1955 no 264-1 pp 202-203

HH Fossil Lake 1946 Carnegie Publ 551:158

A Miller So. Dak Miocene Megapalaelodus connectens tarsus UC Pub Geol. 27: 86

L " Barstow miocene - Condor 52: 70 Tibia M. connectens.

Milne-Edwards —

?. Distinguishing marks of Palaelodus vs Megapalaelodus.

?, Variation among sp. of Palaelodus

Cedros Palaelodus tarsus ~~slightly~~ 7% broader ~~larger~~ than P. goliath T 8% narrower than M. connect,

Distinguished from both in greater elevation of ~~[illegible]~~ int. trochlea

Distinguished from Mega., T similar to Palaelodus, in lateral deflection to post., tip of int troch (greater ant'ly)

T tip more prominently developed

Tibia with papilla lower than in goliath more as in crassipes, Broader than in M. connectens - Depression broader post. to int. condyle (suggested post. Ti ext condyle but this area broken, opening of tendinal groove oval (meg. id.) Pal. closer, no nor [illegible] as oval

Cedros Sula left dist humerus 65148/15413, Br dist end 20.5 av. called by Tedford 1965

Unit F = Cedros 4

Other Sulids (Wetmore Shark tooth Hill paper 1930: 91)

M. loxostyla 21.1

M vagabundus 18.3 (to 17.3 @ 14)

M bassanus 23.7-24.3

M serrator 22.5

M. capensis 22.5

Palaelodus ambiguus M.E P62 Vol 2

Tarsus (inferior) more compressed than in Phoenicopterus
digital trochleae long, median longer than external from which
it is separated by a ~~an~~ (large deep?) interdigital groove. The ~~[illegible]~~ larger
trochlea is elongated, straight & prolonged posteriorly by an
external edge "saillant" & "relevé"

Internal trochlea is short, nearly as in Phoenicopterus but it
is more strongly "rejetée" posteriorly. It presents "en dehors"
a very deep depression for insertion of the int. artic. ligament
and is terminated posteriorly & laterally en dehors by an edge
"saillant et relevé," while in the flamingos this edge is
straight droit and ~~directly~~ directed directly posteriorly.
pointed?
Furthermore in the latter bird, the ~~trochlea~~ "livre" gorge of the ext.
trochlea is deeper & its external lip as well as being
very ~~[illegible]~~ thin is more prominent than that of the opposite
side, which is not the case in Palaelodus.

The lower foramen in P. ambiguus is situated a little
distance from the interdigital groove & is prolonged distally
by a deep "sillon" which anteriorly separates the
median & ext. trochleae. Behind it opens nearly
on the median line of the bone, the artic facet for the
great toe is scarcely apparent as in Phoenicopterus

Tibia of P. ambiguus – inferior part
Artic. surface very aplatie flat and presents on each side of the
median line a rather deep depression in which lodges the
posterior ~~part~~ edge of the glenoid facets of the tarsus. These
depressions exist in Phoenicopterus & one sees traces
of them in the Gruids, Ciconids & Totanids. The rotular
gorge is short, but less deep than in Phoenicopterus; 's
resembles that of species of "Chevaliers," "En dehors" the
ext condyle, one sees no trace of the oblique "gouttière" which
exists in Phoenicop.

~~papilla for~~ inferior insertion of oblique ligament situated slightly above
internal condyle, while in flamingos it is found above the supratendinal bridge
One doesn't find there the tuberculiform attach which one finds
in the median line (in gruids, ciconds & flamingos) outside the
orifice inferior of the groove of extensor of digits + which serves for
insertion of a ligament destined to bridge the tendon of this muscle
This tubercle is replaced by a "saillie" very light analogous to
the one seen in the Totanids

Palaelodus crassipes ME p 77 vol. 2 br. tarsal trochlea 16.8, br dist tibia 16.9

Tarsus very robust. Lower end very enlarged and "surtout" + more "renflée" than in the preceding birds (ambiguus, gracilipes + minutus) The median trochlea is high + ~~broad~~, the internal rounded in front + much less "étroite" than in P. ambiguus.

Palaelodus goliath ME p. 79 vol. 2, br + tarsal trochlea 18,5, tibia br dist. 18,0

br tarsus 19.5 Aedus 2d

Tarsus more robust than P. crassipes, however, as in the other species of the genus, its lateral "faces" are more enlarged than the anterior the lower end is very "renflée" + the digital trochleae are long + very ~~broad~~ grosses - placed the same as in the other species of Palaelodus.

Alden's Megapalaelodus connectens -

outer rim of trochlea for digit 4 more pronounced than in Palaelodus (line from inner + outer rim forms 60° angle with axis of shaft). In Palaelodus ∠ 35½-47° + in Phoenicopterus 92°.

Finch?
Don Fisk (Fisher?)
mapping our Laguna Hills area

angle of ext. trochlea inner + outer edges to axis of bone		ht of trochlea (cut above dist end of middle troch		br dist troch.
P. ambiguus	41½° Pl 85 fig 1	7,4	61.6% of br.	12.0 mm
P. ~~gracilipes~~	42½° Pl 88 fig 12	4,8	43.6% of br.	11.0 mm
P. minutus	49° Pl 86 fig 17	—		—
P. crassipes	50° Pl 88 fig 9	— 7 mm	41.6% of br	— 16,8 mm
P. goliath	46° Pl 87 fig 1	— 7,8 mm	42% of br	— 18,5
Aedus	42° H	8.8 mm	44% of br.	.19.9 gr. 21 diag
Megapal. connectens 60°		5.0 mm	23% of br?	21.6? gr 22.7 diag

However,
Comparing the contour of the trochlea, with Cedar Id specimen as seen in
internal view with the cast and ~~with the~~ illustration
of M. connectens (Miller 1944: 86, fig 1a) and with
a cast ~~the illustrations~~ of Palaelodus ambiguus & illus of that
sp. & P crassipes & P. goliath (M. E 1868, ~~vol.~~ Plates
vol. 1, pls 83, 87 and 88) the similarity is closer to
~~the~~ Palaelodus than to M. connectens.

A second character said to distinguish M. connectens
from Palaelodus is "posterior margin of trochlea for
digit II, viewed from medial side), less abruptly
deflected from shaft --- and lacking a sharp
process at the posteroproximal angle." ~~The~~ On Cedar
tarsus the posterior margin of the internal trochlea is
markedly deflected and is bordered by a ~~prominent~~ heavy protruding ridge
~~is more prominent~~
~~with a distinct~~ ~~protruding~~ ~~which is expanded~~
~~forms a prominent angle~~

A further distinction bet Mega & Pal, which is suggested from the material
& illus at hand is the ~~more distal~~ position of the int trochlea
in Mega, ~~being more distal & lo~~

9 46.1
7 ~~3~~ 32.9 Mega.
~~3 41.6~~

crassipes
7.4
7.6 goliath

14.9 70%
11.6 54%
7.6 63

M 7.1 – 33.4 – 2.3
a. 4.6 – 38.4 – 1.7
Ced 9.4 48 – 2.2

~~7.4~~
5.1 42.5
9.4 48. ✓
9.3 – 34.2

14.7 / 18.5 = 79.5
13.7 / 16.8 = 81.5

9.8 / 12.0 = 81.6%
15.7 / 21.3 = 73.7% Mega
15.7 / 19.5 = 81.1%

LHM or ME = published data by ME or LHM
illus = meas made by HH on illus.

Paloelodidae

Sept. 22, 1970

Cedros 3d study

	Tarsus				Tibia				Tarsus								
	Length tarsus	Br prox tarsus	Gr Br dist troch tarsus	Br across troch at RL to shaft	Length tibia	Br prox tibia	Br dist tibia	Depth dist tibia	~~Ht~~ Int troch above mid. troch	Ht ext troch above mid troch	Depth ~~Ext~~ troch / int.	Br hypotarsus	Depth prox thru hypotarsus	Br ext troch / Depth	Br mid troch / Depth	angle center to mid line ext troch.	Ht int. / Ht ext cond
Paloelodus																	
P. minutus	106		—		—											49°	
P. gracilipes	102	13.0	illus 11.8 →	ME 11.0	—		ME 12.0		45.5% of br. 5.0mm	2.5						42°	
P. ambiguus	121	14.0	illus 12.7 →	ME 12.0	172.9		ME 13.0		58% of breadth 7.0mm	3.0						41½°	
P. crassipes	ME 145	ME 16.0	17.9 illus	ME 16.8	—		ME 16.9.		41.5% of breadth 7mm			illus 9.4				50°	
P. goliath	149	—	illus 19.5 →	ME 18.5	229		ME 180		42.2% of br. 7.8mm	3.0		—		6.0 illus? / 12.0 illus?		46°	
Megapaloelodus																	
M. connectens	—	—	Alden 22.7	LHM 21.3			LHM 17.0		5.0	3.0	14.3 alden / 16.0 alden		—	5.6? alden / 14.3 alden	9.2 illus / 13.7 Alden	60°	
M. opsigonus	—	19.6	—	—								10.1		—			
Cedros	—	—	HH 21.0 ant'ly near to projecting tip of Troch for digit 2	HH 19.4 ~~19.6~~			HH 18-19?		48.5% of br. 9.4? ~~9.7?~~	2.8mm	13.6 / 13.5	←	—	[illegible] / 13.2	8.9 / 14.0	42°	12.9 / 13.1
Recent Phoenicop.																	
P. antiquorum		18.1-18.7	19-22														
P. ruber		15.5-17.6	18-20														
P. chilensis		16.3-16.8	19-20														

Nov. 11, 1970

Order Ciconiiformes: Suborder Phoenicopteri

Family Palaelodidae

A distal end of a large tarsometatarsus (LACM 15423) from Arroyo Delphin (LACM locality 65148) is referred to the genus Palaelodus on the basis of characters set forth by A. Miller (1944:86) in distinguishing Palaelodus and Megapaloelodus connectens .

This is the fourth record of a palaelodid flamingo in North America, but the first to be referred to the genus Palaelodus. The other six species of Palaelodus are known from the Miocene of France and Germany. American palaelodids have been referred to two species of the genus Megapaloelodus recorded from the Miocene of California and South Dakota and the Pliocene of Oregon. The type of the Miocene Megapaloelodus connectens Miller is a distal end of tarsometatarsus approximately 7 per cent larger than the Cedros Island specimen, and, as noted above, qualitatively distinguishable.

The type of Megapaloelodus opsigonus Brodkorb from the Pliocene of Oregon is a proximal end of a tarsometatarsus with a recorded breadth of 19.6 mm. The relative widths of proximal and distal ends of the tarsometatarsus apparently varied in the palaelodids. In some species of Palaelodus as recorded by Milne-Edwards (ref.— × proximal breadth exceeded the distal breadth, but in another, the proximal end is slightly narrower than the distal end. It is, therefore, within the range of probability that the Cedros tarsometatarsus, with a distal breadth of 19.8 mm could belong to the species from Oregon ~~represented by a tarsometatarsus with a proximal breadth of 19.6 mm.~~ The fact that both are early Pliocene in age strengthens the probability.

Brodkorb's referral of his species to Megapaloelodus was logical since only this genus had been previously recorded from

In view of the size and age of the Cedros & Oregon bones, Brodkorb (correspondence) agrees with me that the two are likely of the same species. He states further that he would not

North America. ~~He states, however~~ (correspondence), that ~~he~~ ~~would not~~ consider untenable the reassignment of ~~the species~~ opsigonus to Palaelodus ~~to Palaelodus~~ in view of the Cedros occurrence. The Cedros Island bone is therefore referred to opsigonus with this generic revision.

Mega ~~P~~alaelodus opsigonus (Brodkorb)

Characters of the proximal end of the tarsometatarsus of this species have been described (Brodkorb, 1961:175). Charaaters of the distal end, based on Cedros Island specimen LACM 15423, are as follows: Line from outer to inner rim of trochlea for digit 4 forming 42° angle with axis of shaft, which is within the range of Palaelodus (35° - 47°) as distinguished from Megapaloelodus (60°) (A. Miller, 1944:86); internal trochlea elevated 9.4 mm above middle trochlea, or 48 per cent of transverse breadth of distal trochleae (41-58 per cent in Palaelodus, ~~2~~33 per cent in Megapaloelodus as estimated from illustrations); posterior tip of internal trochlea with prominent raised border, deflected from the shaft so as to be visible in anterior view; external and internal trochleae nearly equal in anteroposterior dimension. Seven per cent broader than largest specimen of Palaelodus recorded by Milne-Edwards (P. goliath) and further distinguished from P. goliath by more elevated internal trochlea and less developed outer rim of external trochlea (see Table).

A distal fragment of a tibiotarsus (LACM 15422) from the same Arroyo Delphin locality, and commensurate in size with the tarsometatarsus, is also referred to P. opsigonus. All contours are badly worn but certain diagnostic characters are visible. The small size and lateral position of the anterior intercondylar tubercle are characteristic of the Palaelodidae as is the low median ridge around the posterior part of the distal articular surface. The small fossa

Palaelodus study.

Ⓑ

18–20 = range of br dist end tarsus rather = 11%

15.5–17.6 = " " " prox " " " = 14%

br prox opsigonus = 19.6 + 14% = 22.4 mm

" " " = 19.6 – 14% = 17.2 mm

br dist end P. from Cedar 19.6 + 11% = 21.8 mm gr. br. 21.0

" " " " " 19.6 – 11% = 17.6 mm

" " " megapal. connectens = 21.3 gr. br. 22.7

Ratio prox to dist end tarsus

P. ambiguus 14/12 = 116%

P. gracilipes 13/11 = 118%

P. crassipes 16/18.6? = 116%

greatest opsigonus (22.4 est) could have at 116% dist end 19.3 mm dist

" " " " " at 118% " " 19 mm "

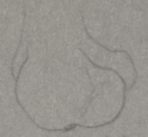
least " (17.6 mm est) " " at 116% " " 15.2 mm dist

type " 19.6 " " at 116% " " 16.8 mm "

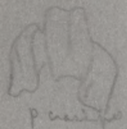
51.6

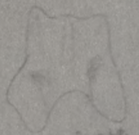
ME pl 87 + 88
vol 1

Palaelodus


P. crassipes
L tibia

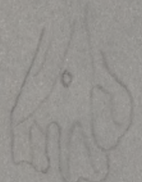
R tarsus

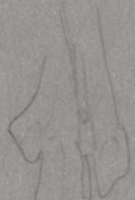

P crassipes


P goliath
R tibia

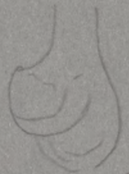
R P crassipes
int

P crassipes
R ant


Post. view
P. goliath


ant view
P goliath

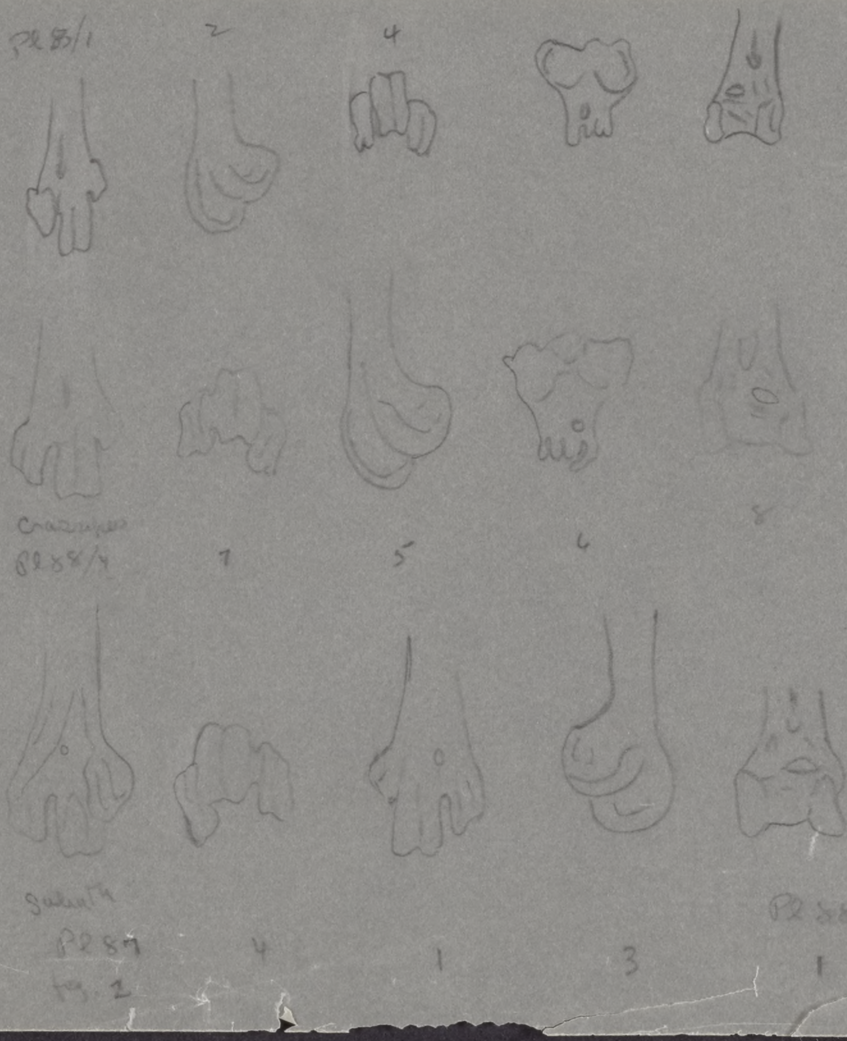
post view
P goliath



int view ← P goliath → dist view
L tarsus
left tarsus

8 + 1 table
+ 2½
+ 2 , 1 table
4
3

19½ + 2 table
+ 3 or 4 views



Tracings from
Milne-Edwards
Palaelodus

Megap Paloelodus opsigonus Brodkorb ~~americanus~~ ~~n. sp.~~

~~Holotype:~~ Distal end of left tarsometatarsus, LACM 15423; collected by Whistler and Jefferson July, 1964.

Locality: LACM loc. 65148, Arroyo Delphin; approximately .....feet above Miocene-Pliocene contact; north side of Valle Blanca, 1½ miles south of cannery villeage, southeast corner of Cedros Island, Baja California, Mexico

Formation and Age: Almejas Formation; early Pliocene.

Diagnosis: Line from outer to inner rim of trochlea for digit 4 forming 42° angle with axis of shaft (within the range of Pal~~o~~aelodus as distinguished from 60° angle in Megapaloelodus, Miller, 1944: 86). Distal end approximately ~~7~~ 6 per cent broader ~~recorded measurements~~ than in Pal~~o~~aelodus goliath Milne-Edwards and ~~1~~8 per cent narrower than in Megapaloelodus connectens Miller. Internal trochlea elevated 8.8 mm above middle trochlea (7.8 mm in P. goliath and 5.0 mm based on illustrations in Megapaloedus connectens) and having prominent, raised border on blunt posterior tip, slightly deflected laterally; external and internal trochleae nearly equal in antero-posterior dimension.

Tw

Referred specimen: Distal fragment of tibiotarsus, ALCM 15422 from type locality. All contours are badly worn but certain diagnostic characters are visible: the small size and lateral position of the anterior intercondylar tubercle are characteristic of the Paloelodidae as is the low median ridge around the posterior part of the distal articular surface. The small fossa posterior to the internal condyle on the distal surface can be discerned, but the area around the external condyle has been eroded away. Anteriorly the supratendinal bridge forms an oval opening at its distal margin; this opening is round in Megapaloelodus connectens (as figured by L. Miller, 1950 no) and slightly oval in the species of Paloelodus illustrated by Milne-Edwards (1867-1868), though less ~~so~~ oval than in P. americanus.

Measurements: Greatest breadth (diagonally) across distal trochleae of tarsometatarsus 21.0 mm (M. connectens 22.7) P goliath 19.5 (illus), breadth of distal end at right angles to shaft 19.6 mm (M. connectens 21.3 mm) P goliath 18.5), height of internal trochlea above distal edge of median trochlea ~~8.8~~ 7.9 mm (M. connectens 5.0 mm dist from illus) P goliath 7.8 from illus), antero-posterior depth of internal trochlea ~~...~~ 13.5 mm (M. connectens 16.0). Approximate breadth of distal end of tibiotarsus 19mm.

Discussion: The paloelodid flamingos have three other Tertiary records in North America, but this is the first new world record of the genus *Pal~~o~~aelodus.* The other six species of the genus all occurred in the Miocene of France and Germany. American pal~~o~~aelodids have been limited to to the genus *Megapaloelodus* recorded from the Miocene of South Dakota and California (*M. connectens*) and the Pliocene of Oregon (M. ~~oregomus~~ opsigonus Brodkorb). The latter species is based on a proximal end of tarsometatarsus said to be "~~slightly~~ much smaller than P. ~~crassipes~~ goliath Milne-Edwards". ~~xxxThe distal end of the tarsometatarsus of the latter species~~ is as measured by MFE ~~20~~ 6 per cent smaller than in *P. americanus*, Measurements: Greatest breadth (diagonally) across distal trochleae of tarsometatarsus 21.0 mm, height of internal trochlea above distal edge of median trochlea 8.8 mm, antero-posteeior depth of internal trochlea ...., height of external trochlea above median trochlea ....

Tabe of Measurements of Palaelodids

	Tarsometatarsi ~~P~~M. opsigonus 15423 ~~UOF545~~9	P. goliath	Megapaloelodus connectens
Transverse ~~br~~ breadth across distal trochleae	19.8mm	18.5mm	21.3mm
Distance of internal trochlea~~e~~ above middle tro- trochlea	9.4	7.8	5.0
Ratio of height of internal trochlea to breadth distal end	48%	42%	23 %
Angle with axis of shaft formed by line passing from inner to outer rim of external trochlea	42°	46°	60°

College of Medicine
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Department of Anatomy
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Mailing Address: P.O. Box 6998 · Chicago, Illinois 60680

5 January 1971

Dear Hildegarde:

Under separate cover I am sending you the flamingo casts I promised. They are going first class so should beat this airmail letter.

The casts are fairly good and can be used for diagnosis. You will note that the notches of _M_. _connectens_ are not "clean," but it is still possible to tell the boundaries of the notches. This should cause no trouble. If it does I will send you a new cast.

Also enclosed here is the congress photograph.

I have no new comments on flamingos. Of late my mind has been on cathartids. Pat Rich and I have just finished our rather long ms on Old World cathartids and should submit it to Condor (for the Miller memorial) within 2 weeks. No doubt you will get it from Ralph.

Hope all is well and t hat you have a productive new year.

As always,

Joel

Joel Cracraft

The American Museum of Natural History
Central Park West at 79th Street New York, New York 10024 (212) 873-1300

DEPARTMENT OF ORNITHOLOGY

19 December 1970

Dear Hildegarde:

Here are some comments on these flamingos. As soon as I get back to Chicago at the end of this week I will send you some casts and perhaps some further comments.

Concerning Millers original description of Megapaloelodus:

a. "outer rim of trochlea.....in Paloelodus, 92^0 in Phoenicopterus)" I cannot see this character; moreover I find it impossible to really be sure how he was measuring this angle. I really do not believe that the outer rim is more pronounced.

b. "posterior margin....at ~~pxx~~posteroproximal angle;" the posterior margin character seems valid; however the area of the process is broken off in M. connectens thus who can be sure. This does not seem to be a strong character anyway.

c. "size"; of no generic value.

Miller forgot what may be the most important difference, namely, that the trochleae of Paleolodus are much closer together, i.e., the intertrochlear notches are wider in Megapaleolodus. This is about the main difference. Perhaps you will find others, but probably they will not be "strong" differences.

Concerning Pierce's diagnosis on the proximal tarsometatarsus:

a. "intercotylar knob high" true, but not all that much.

b. "cotylae shallow" hard to tell from his photograph, but the difference does not seem that significant.

c. "tubercle for tibialis anticus higher on shaft" cannot tell from his photograph; this could be age character; not a strong generic character.

d. "hypotarsus wider but more restricted plantad" whether it is proportionately wider or not I have doubts, but it does seem deeper anteroposteriorly in Paleolodus. (But see below).

e. "groove plantar to first hypotarsal canal wider." True, but see below.

f. "second flexor channel a groove, not a tube" true, but see below.

It is evident from his figures that his tarsometatarsus is very worn especially posteriorly and so I suspect characters b,d,e,f, might be due to this. Perhaps you ought to have him send you the specimen or a cast.

Basically I do not see many hard characters for recognizing a different genus. I am slowly changing in this respect since some of my earlier work will not reflect this view. The distal opening of the supratendinal bridge which you mentioned is probably very variable and so I would not use this. Anyway, whatever you decide, be sure to discuss in detail the characters involved.

I am beginning to think that it probably would be best to recognize flamingos as a suborder. They are probably, no almost certainly, closer to the other ciconiiforms than are the anatids.* Pat Rich and I have finished our vulture paper for Condor. Just a little more work.

Best for the holidays
Joel

* If placed in a separate order, then there should be a superorder to show that phoenicopteriforms and ciconiiforms are closer to one another than to other groups.

2045-Q Via Mariposa East
Laguna Hills, Calif. 92653
January 19, 1971

Dear Joel:

The Palaelodid casts were duly received and much appreciated. Forgive me for not writing sooner. I kept putting it off thinking I might be able to make some earthshaking comments about my findings re Palaelodus vs Megapaloelodus! No such luck. Previously I thought I could make that measurement of the angle formed by a line from the inner to outer rim of the external trochlea with the axis of the shaft. I'm still trying, but am about to give up.

Oh, another thing -- those two small casts: I took it for granted they were of Palaelodus ambiguus (genotype as now established). But I see the tibiotarsus is a right and the ME figured specimen is a left. So -- what have we here, please? Also the proximal end of the tarsometatarsus doesn't have the same contours as ME's figure (Plate 83).

The most notable difference between my specimen and that of Megapaloelodus connectens (both as seen in Miller's illustration and on the cast) is that in the Cedros specimen the internal trochlea is more elevated and more rotated medially (and, to me, medially means towards the middle of the shaft not toward the internal side of the bone; a convenient way of making a distinction). In spite of the "medial" rotation of the trochlea as a whole, however, the posterior tip is strongly deflected away from the shaft, that is "laterally." This, and other more subtle characters I am still fretting over, seem more like Palaelodus.

My paper on the Cedros avifauna is done except for the Palaelodid. And as it is very long for Condor and requires two plates that must be made up of a number of bones, I will submit it to the Museum's Contributions rather than for the Memorial Issue of the Condor. It would be impossible to follow the Condor's instructions for composing plates. Apparently Condor never routs out backgrounds as Contributions always will do when necessary. So now I will have to get busy on another problem for the Memorial Issue.

I am looking forward to seeing you at Cooper Society in April. I understand it is to be at San Diego State. But do you know the exact dates? Ken Stager said he thought it would be from April 6 to 9, but that would be mid-week. I hope you will have time to come to the Museum in Los Angeles while you are on the coast.

Thank you very much for the photo of the "fossil birds" at the IOC. Only four did I recognize without referring to the list. You and Harrison seem to be the only ones in the mode (for hair, that is!).

Best wishes,

Hildegarde

Aug. 24, 1970

Cedros Island Alcidae (total of 8 bones)

See also dist. end ulna from 65151 unnumbered
and prox end humerus from 65151 unnumbered
cranium 65144/15426

Same sp.

Two proximal ends humeri 65148/15420 and 65153/15408 number washed off ~~3~~ or 8

One proximal end ulna 65153/15406

One fragment of shaft & upper part of trochlea of tarsometa. 65153/15407

One upper end coracoid 65148/15421 numbered anew

Measurements

Humerus	Br prox end	Ratio pect scar length to prox end br	Prox lor to int edge of head	pectoral scar anconal length	/ bread gr.	br head	depth	ht	dimension of shaft below deltoid crest immediate least	greatest	ratio to br prox	Br bet. pneumatic fossa & pect. scar
15420	—	↓	8.8 mm	5.45	67%	3.65	4.4	3.9	—	—	33.4%	3.5
15408	10.5	45.5%	7.5	4.8	62.5%	3.0	4.1	3.5	3.1	4.25	34.3%	3.6
Rec. Bi1177 Brachyramphus marmoratus	10.5	45.5%	7.5	6.0	29.2%	1.75	4.4	4.5	3.2	4.4	—	—
fos. B. pliocenus Howard	11.5		—	—		—			2.5	4.6		
Bi 493 Ptychoramphus aleuticus	10.2		7.2	? has papilla prox'ly		1.35	3.8	3.6	2.8	3.9	45.1%	4.6
Bi 687 Synthliboramphus antiquus	10.2	51%	7.3	has papilla prox-distally 5.2	40.3%	2.1	4.1	3.5	2.7	3.9	44.2%	4.5
Bi 664 Endomychura craveri	9.8	49%	7.1	4.8	54.2%	2.6	3.8	3.5	2.9	3.6	39.8%	3.9
Bi 524 Cerorhinca monocerata	14.05 (14.3 #631)	55%	9.8	8.0	47.0%	3.75	5.9	5.4	3.9	5.4	40.5%	5.7

Tarsometa.	least br	depth	br. at foramen	length from foramen to prox papilla (top of)	Ratio depth to br shaft	gr length
15407	2.7	1.9	4.25	12.8?	70%	—?
Bi 1177	1.8	1.2	3.0	9.2?	66.6	17.1
Cerorhinca dubia Miller				16.6?	[illegible]	29.0
Bi 493	2.1	1.7	3.3	16.0	81.0%	24.5
Bi 687	1.6	1.8	2.6	18.6	112%	26.5
Bi 664	1.3	1.5	2.2	16.6	115%	24.0
Bi 524	3.8	2.6	5.2	15.85 (16.8 #631)	68.5%	28.5
P. tenuis Miller & Bowman	1.9	1.6	3.5? est from illus.	~~15.5~~ est from cast	84.3%	21.7

Ulna	br prox, at anconal edge of cotylae	%	depth prox thru int cotyla		ratio depth to sh to prox end	brachial impression length	%	/ breadth	middle shaft breadth	%	depth	ratio br to depth	ratio br to depth prox end
15406	5.1	93%	5.5	~~64.7~~	45%	8.6	24.4%	2.1	2.3	70%	3.3	69.6%	92.6%
Brachy Bi 1177	5.2	92%	5.65	~~67.4~~	42.5%	8.7	16.1%	1.4	2.2	63%	3.5	63.0%	92.8%
Ptychoram. Bi 493	4.8	86.5	5.55	~~73~~	48%	8.8	25.0%	2.2	2.3	66%	3.5	65.7%	86.5%
Synthli. Bi 687	5.4	90%	6.05	~~66~~	45.5%	8.4	19.8%	1.7	2.45	69%	3.55	60.6%	89.3%
Endomy. Bi 664	5.0	85%	5.9	~~64~~	44%	8.2	22%	1.8	2.2	66.5%	3.2	68.9%	84.6%
Cerorhinca Bi 524	6.9	84%	8.2	~~71~~	47.9%	11.0	21.8%	2.4	3.3	67.5%	4.9	67.3%	84.3%
B. pliocenus Howard	4.8	80%	6.0	~~77~~	~~54.3%~~				2.6	70.5%	3.7	70.3%	80.0%
A. Nosamori	3.9		—		43.5%				1.7	85%	2.0	85.0%	102.3%

Characters of ulna Cedros Island # 15406

① olecranon short & blunt
② brachial impression short & nearly to middle of shaft (ancon-palmad)
③ anterior artic. lig. attach. prominent, with pt'd tip, but with flat surface
and brachial impression undercuts it palmad
④ Shape of shaft – moderately rounded – not extreme blade

Agrees with:
① Cerorhinca, Ptychoramphus, Aethia
② Cerorhinca, Aethia, Cyclorhynchus
③ Cerorhinca (tho more prom. than C.)
④ Cerorhinca, Synthliboramphus, Endomychura, Ptychoramphus, Cepphus, Aethia, Cyclorhynchus

Check type ulna of Aethia rossmoori

Characters of coracoid
① Procoracoid long; if foramen present would be low down)
② Scapula facet oval? sort of an oval & triangle
③ Highest pt of furcular facet – middle
④ Triosseal canal rounded
⑤ Prox. lig. attach very large (occupies whole ant. face of head)
Agrees with;
① Uria, Cerorhinca, Pinguinus, Alca, Synthliboramphus, Endomychura, Lunda
doubtful; foramen should show

② ~~Uria, Cerorhinca, Pinguinus~~ ? check this
③ Cerorhinca, Ptychoramphus, Lunda, Aethia, Cyclorhynchus, Endomychura
④ Cerorhinca, Synthliboramphus, Endomychura
✓ 5 check this

Characters of tarsus
① broad, well depressed
Agrees with:
① Cerorhinca, Lunda

Characters of humerus
① Deep narrow space below head between pneumatic fossa & pectoral scar
See next page

Note: Storer groups the alcid genera as follows;
Fraterculini; Lunda, Fratercula, Cerorhinca
Aethiini: Aethia, Cyclorrhynchus, Ptychoramphus
Synthliboramphini: Synthliboramphus, Endomychura
Alcini: Alca, Uria, Pinguinus
Brachyramphini: Brachyramphus
Cepphini: Cepphus
Plautini: Plautus (P. alle, Dovekie)

from same Miocene stem Miocepphus

Aug. 25, 1970 Cedros Island Alcidae p. 2

Characters of humeri #s 15408 (best preserved) & 15420

① Very narrow and very deep channel undercutting head between median edge of pneumatic fossa and pectoral attachment

② Pectoral attachment very broad and set slightly slanted to head prox'ly (helps to form narrow channel noted in ① above.

③ Brachial depression (on palmar side) small – deep, pit like.

④ Bicipital crest protrudes from shaft abruptly

⑤ Shaft sturdy (not blade like)

Note: – The tarsometatarsus is markedly different than
Endomychura (which is slender with trochlea 1 set post'ly)
Synthliboramphus " " " " " " " "
Brachyramphus (which tho short with broad distal end, narrows in center and trochlea 1 is entirely above middle trochlea
Ptychoramphus – which is more slender of shaft (tho not as slender as Endo & Synthli) and is not depressed
Aethia & Cyclorrhynchus – both of which are slender
Cepphus very slender

It is, however, like Cerorhinca in being broad in shaft & depressed centrally. The distal trochlea 1 is not set as far post'ly as in those listed above

Possibly it is like Lunda & Fratercula also,

Size of tarsus relative to Cerorhinca monocerata 79% length, 71% breadth sh.
Size of humerus " " " 75% br. prox end
Size of ulna " " " 73.8% br prox end, 67% depth prox end
Size of coracoid " " " 78.5% ht from scap facet to head also br. below head

Measurement of coracoid

	distance from scap. facet to head	below	B, below furc. facet	br ? furc facet	highest pt on furcula facet	depth head
15421	9,65	90 30%	2.9	3,9	2.7	4,4
Brachyramphus Bi 1177	9,5	26.2%	2,5	5,0	2,5	4.3
Ptychoramphus Bi 493	8,1	28.2%	2,2	3,9	2.5	3.7
Synthliboramphus Bi 687	9,0	26.8%	2,4	4,6	2,35	3,8
Endomychura Bi 664	8,9	24.6%	2,2	4,15	2,4	3,3
Cerorhinca 524	12,25	30,2%	3,7	6,75	3,3	5,9

Cerorhinca ~~[illegible]~~ minor

Holotype: Proximal end of right humerus, LACM 15408 collected by Whistler + Jefferson July 1964,

Locality: LACM 65153, ridge between Arroyo + [illegible] (west) + Arroyo Delfin (east), north side of Valle Blanco, 1½ miles south of cannery village; southeast corner Cedros Island, Baja Calif., Mexico.

Formation + age: Salada formation, early Pliocene.

Referred specimens: ~~Prox. end humerus 1544~~ from the type locality, prox ~~end~~ half ulna 15406, ~~dist~~ incomplete ~~end ulna~~ tarsometa 15407; from locality LACM 65148 (Arroyo Delfin) incomplete right prox end humerus 15420 and upper end of coracoid 15421; tentatively, from loc. 65121 (Arroyo + [illegible]) ~~Text~~ (~~uncatalogued~~) ~~prox~~ dist. half of ulna (~~number?~~ to be catalogued) slightly larger than others

Diagnosis: Humerus: Head smoothly rounded ~~and~~ overall, deeply undercut ~~[illegible]~~; with medial edge of undercutting channel ~~with~~ on line with + continuous with medial ~~border~~ of pneumatic fossa, more pneumatic fossa ~~irregularly~~ more round than oval, more than 30 per cent smaller than in Cerorhinca monocerata.

Ulna with olecranon blunt + relatively short, ~~brachial impression~~ attach of ant artic ligament ~~with flat surface~~ ~~clasp~~ ~~prominent than in C. mono, but~~ with flat surface as in C. mono, but surface more prominently projected from ant'ly ~~[illegible]~~ of shaft; ~~shaft relatively~~. Shaft ~~more rounded than in~~ less flattened ~~often~~ than in C. mono, + ~~relatively~~ hence broader rel. to depth.

Tarsus short, + broad + well depressed ant'ly as in C. mono, but about ¾ the size, ⅔.

Coracoid: highest point on furcular facet about middle of facet ~~[illegible]~~ as viewed internally, + [illegible] canal (below facet) narrowed (as in C. mono.) ~~area below furc. facet [illegible]~~. Procoracoid facet less ant'ly projected. Scap. facet a deep nearly round socket. Procoracoid straightly; foramen if present was placed 3.4 mm or more below edge of coracoid.

Shaft meas. bet. papilla 4 + 5 (from dist end or 6 + 7 from prox end

Depth	br.				
4.7	3.3	= 70.3	C. mono.		
4.0	2.7	= 67.5	dist. fossil	from 65151	
3.3	× 2.3	= 89,%	– prox. fossil	from 65153	

br depth 3.4 × 5.1 66.6% at dist. tip of each ulna

2.4–3.4 70.1%

Family Alcidae: Subfamily Mancallinae

Three species of the flightless auk, genus Mancalla are known from the Pliocene, and a possible ancestral form, Praemancalla, from the late Miocene. All ~~have occurred~~ are recorded only from in California. Mancalla californiensis, the genotype, is known from the ~~type~~ humerus type at the Los Angeles loc. and 14 referred bones from ~~a second locality;~~ Orange County; M. diegense and M. milleri are well represented ~~from~~ in the San Diego Formation ~~but only from disassociated skeletal material;~~ M. diegense is also recorded from a single humerus from Humboldt County, and several poorly preserved specimens from Orange County. All previous occurrences have been of disassociated skeletal elements.

In the Cedros Island deposits more than 80 bones of Mancalla have been found, 33 of which belong to four ~~associated~~ incomplete skeletons. The bones are close in size to those of M. diegense, but ~~Several~~ Structural peculiarities of several of the elements ~~differ from~~ serve to distinguish the island form from previously recorded species.

Bones of the flightless auk Mancalla occurred ~~at~~ all LACM localities. Four incomplete skeletons and 50 disassociated elements ~~[illegible]~~ are represented, making a total of more than 80 bones.

1283 Tarsus + ulna (65144) } Esqueletos
1287, 1291 (2) humeria, radius, carpus (65145)
1288 femur + carpus (65146)

— 3 ulnae, radius, tarsus + tibia 65148 } Delphin 1327, 1332, Cedros 4
— 1 ulna 65149 — Cedros 7
— 3 tarsi, 1 ulna, 3 humeri 2 tibiae 65151 } 1292, 1304 Cedros 2 Tiburon
— ulna 65152 — 1323
— 4 humeri, 2 carpi 1 radius, 5 ulnae 1 cora., 1 scap. 1 beak 1 tarsus 65153 — 1312, Cedros 8
— 1 ulna 65154 — 1270

FAMILY ALCIDAE: Subfamily Mancallinae

Three species of the flightless auk, Mancalla, are known from the Pliocene of California: Mancalla californiensis, type humerus from Los Angeles, and 14 referred disassociated elements from ~~Orange~~ ~~coracoid, humeral fragments, ulna, c~~ Corona del Mar; Mancalla diegense, type femur and over 50 disassociated ~~radius, carpometacarpi, tarsometatarsi~~ elements from San Diego, one humerus from Humboldt County and 24 limb elements from Laguna Hills referred; Mancalla milleri, type ~~humerus~~ femur, paratype humerus and over 100 disassociated bones from San Diego.

From Cedros Island, for the first time, associated skeletal elements of an indifvidual have been found

associated elements of four Mancalla skeletons have been recovered.

August 26, 1970

Previous alcid records from California

LATE MIOCENE

Alcinae

Cerorhinca dubia Miller (Lompoc) impression of legs
Cerorhinca sp. (Laguna Hills) ulna (prox) and humeral shaft (C. dubia?)
Alca ap. Laguna Hills fragment of coracoid and dist. humerua
Aethia rossmoori Howard (Laguna Hills) ulna and dist. humerus
tentatively referred: dist. ulna, 3 frag.coracoid
Alcidae spp. Laguna Hills, 2 coracoids (short procoracoidno foramen
prox. end ulna with broad brachial impres.; 2 tarsi frags.
size, one like Cepphus columba, tarsi and ulna larger.

Mancallinae

Praemancalla lagunensis Howard Laguna Hills
Alcodes ulnulus Howard Laguna Hills (Mancallinae ?)

PLIOCENE

Alcinae

Ptychoramphus tenuis Miller and Bowman (San Diego) tarsometatarsus
Brachyramphus pliocenum Howard (San Diego) humerus and 2 ulnae

Mancallinae

Mancalla californiensis Lucas (Los Angeles) humerus
Mancalla californiensis Lucas (Corona del Mar) " , coracoid, tarsus,
carpometacarpus
Mancalla diegense Miller (San Diego) all skeletal elements
Mancalla milleri Howard (San Diego) nearly all skeletal elements

Alcidae wing bones

Cepphus sternum, turns up abruptly
Uria at manubrium + coracoidal
artic flare ventrally

	Humerus					~~Ulna~~ Ulna			Carpus			Carpus cont'd					
Cepphus col.	gr length	prox	dist	br sh	depth sh	Length to olecranon Tr+gr cotyla	br sh	depth sh	Length to dist symph at turn ext length	gr depth prox (int.)	ht prox (ext.)	Length M1	Ht troch above M1 ext	Depth prox ext thru M1	Depth troch int	Depth troch ext	Br troch (prox.)
Bi 1173 ♀	67.8	15.0	7.9	3.7	5.1	56.5 54.9	3.5	5.1	34.6 38.1	9.3	9.8	5.5	4.0	7.4	5.9	4.6	4.6
Bi 1174 ♀	69.0	15.0	7.9	3.7	5.0	57.7 56.4	3.5	5.1	34.8 38.7	9.7	9.4	6.3	3.5	7.8	5.8	4.8	4.8
Bi 1172 ♂	65.9	14.8	7.5	3.7	4.6	55.7 54.1	3.3	4.5	33.8 37.7	9.3	9.4	6.0	4.3	7.7	6.0	5.0	4.6
Uria aalge																	
Bi 674	91.4	17.4	9.0	4.0	7.5	68.8 67.6	3.8	6.1	40.9 46.7	10.8	12.0	7.6	4.7	8.7	7.1	6.2	5.7
Bi 697	86.4	16.8	8.7	4.0	8.0	65.7 64.1	4.0	6.0	38.2 43.3	10.4	12.0	7.5	4.5	8.8	6.9	6.0	5.3
Bi 494	90.8	17.8	8.9	4.2	8.0	69.5 68.2	4.1	6.4	39.5 45.6	11.0	12.9	8.3	5.0	9.3	7.3	6.0	5.3
Bi 507	89.4	17.2	8.9	4.0	7.7	67.0 65.7	3.9	6.1	39.7 44.7	10.7	12.3	7.8	5.0	9.0	7.2	6.3	5.3
Bi 485	86.7	16.7	8.8	3.7	7.0	65.0 63.3	3.8	5.8	38.3 43.3	10.3	13.0	8.5	4.6	8.7	7.3	6.1	5.6
Bi 480	83.2	16.3	8.5	4.0	7.5	63.7 62.3	3.8	6.0	38.3 44.0	11.0	12.6	7.8	4.8	8.8	7.4	6.4	5.2
Bi 477	86.3	16.7	8.8	4.3	7.9	65.4 63.9	4.2	6.6	—	10.8	12.6	7.8	5.0	9.0	7.6	6.0	5.5
Uria lomvia arra	7)614.2 87.7					7)465.8 66.4 cotyla 65.0			ext 6)267.6 44.6								
Bi 1068 ♀	86.5	17.5	9.0	4.5	7.5												
Bi 1068 ♂	90.3	17.8	9.3	4.5	7.0												
Lunda cirhata																	
Bi 696	78.2	16.1	8.2	3.5	6.0	61.1 60.4	3.5	5.6	35.7 40.7	9.9	10.7	7.9	3.4	7.9	6.7	5.3	5.3
Fratercula cornic																	
Bi 661	70.0	14.3	7.9	3.6	5.3	58.0 57.0	3.4	4.8	33.2 37.6	9.0	9.1	6.5	3.3	7.1	5.6	4.3	4.8
Bi 860						55.6	3.4	5.3	33.7 38.0	10.0	9.8	5.7	4.5	8.0	6.1	5.0	5.1

Alcidae Humeri

an eroded Carpus in Miller coll. is probably assignable here also, it resembles B. marmoratus in gen but is larger.

	a	b	c	d	e	f	g	h						
	gr length (to cond.)	length to ectepi pr.	Br prox	Ht head / ~~Depth~~ head	Length pectoral attach.	Ht ectepi prox above condyle	Br distal	Br sh / depth sh mid	Ratio fg	Ratio ec	Ratio ht to ~~depth~~ head	Ratio ht head to br prox	~~Depth~~ int side dist / depth ext. side dist	Ratio depth ext to depth int side dist.
Ptychoramphus 517	46.3	39.3	10.4	3.7/3.8	6.8	5.8	5.3	2.3/3.9	109	65.5%	97.5%	35.6	6.2/3.9	62.9
493	45.7	38.0	10.1	3.4/3.7	6.6	5.8	5.1	2.3/3.7	113	65.4%	92	33.6	6.3/4.0	63.5
296	47.8	40.7	10.0	3.3/4.1	6.9	5.9	5.2	2.3/3.6	113	69.0%	85	35.0	6.1/3.9	64.0
518	47.9	41.1	10.0	3.7/3.8	6.7	5.8	5.1	2.2/3.9	113	67.0%	97.4	37.0	6.2/4.1	66.3
Endomychura craveri 664	43.5	36.1	9.8	3.4/3.7	5.6	6.1	4.6	2.2/3.9	132	57.2	92	34.7	5.9/4.1	69.5
665	42.8	35.7	10.1	3.3/3.7	6.1	6.2	4.7	2.3/3.8	132	60.4	89	32.7	5.5/4.1	74.5
1132	42.7	35.9	9.2	3.2/3.5	5.8	5.7	4.5	2.3/3.7	124	63.0	91.3	34.8	5.3/3.8	71.7
E. hypoleuca 379	46.2	38.4	10.3	3.5/3.8	5.1	6.7	4.8	2.2/4.1	131	49.6	92.3	34.0	5.9/4.2	71.3
561	46.6	39.8	10.2	3.2/3.9	5.6	6.1	4.7	2.2/4.0	130	54.9	82.0	31.4	5.6/4.0	71.5
667	46.3	38.7	10.0	3.5/4.1	5.3	6.5	4.5	2.3/3.8	135	53.0	85.4	35.0	5.9/4.1	69.5
825	44.2	37.0	9.6	3.3/3.5	5.5	6.1	4.6	2.1/3.6	132	57.3	94.3	34.4	5.2/3.7	71.3
Brachyramphus 500	48.8	40.7	10.3	4.4/4.3	6.0	6.7	5.1	2.3/4.9	131	58.3	102	42.7	6.0/4.4	73.3
1177	49.0	41.4	10.2	4.0/4.2	6.4	6.8	5.1	2.3/4.5	133	62.6	95.3	39.2	5.8/4.1	70.7
1178	50.2	41.7	11.1	4.4/4.3	6.5	7.1	5.1	2.3/4.4	139	58.5	102	39.8	6.0/4.6	76.7
1175	48.9	41.1	10.3	4.0/4.1	6.1	6.9	5.1	2.5/4.4	135	59.3	97.5	38.8	5.9/4.4	74.5
Synthliboramphus 693	51.2	42.9	10.6	3.5/4.1	6.1	6.8	5.0	2.5/4.1	136	57.5	85.4	33	6.0/4.5	75.3
1732	50.8	43.0	10.6	3.6/4.2	6.0	6.9	5.2	2.3/4.2	132	56.5	85.7	34	6.0/4.5	75.3
S.D. 2119 Fossil	—	41.3	11.5	4.4/4.9	6.8	—	—	2.5/4.6		Brachy. 59.1%	102.1	40		
Miller 2218						8.0	5.5	—	range 145%	—			6.4/5.1	79.7
SDM 2152						6.7?	5.1?		131				5.7/4.6?	80.7

Humerus 2119 most closely resembles Brachyramphus in ① contour of pneumatic fossa; ② ht of head; ③ supplementary ridge on ext. side of palmar surface of shaft below the deltoid crest (almost an extension of that crest). It differs, however in being ① slightly ~~larger~~ heavier ② intermuscular line extends distally below pectoral scar slants more toward anconal side of shaft producing a slight ridge bordering the ext. side of the prox part of the shaft ~~at the~~ anconally. This ridge appears to take the place of the crest like development of the shaft anconally in B. marmoratus ~~and~~ ③ the shaft is straighter & more convex from this ridge to the int. side under the pneumatic fossa; in marmoratus the shaft slopes markedly palmad in this area.

Distal end L.H. Miller #2218 apparently belongs to the same sp. as it is approaches Brachy more closely than any other genus & is slightly larger than B marmoratus. The ectepi proc. is 145% of the distal end as contrasted with a max. of 139% in Brachy.; the ext cond. is deeper rel to the int. (79.7% as against 76.7 in Brachy.; in all other genera it tends to be smaller)

A 2nd dist. end SDM 2152 is probably assignable here also tho it is badly worn

Tarsus 65153/15407 is much smaller than Cerorhinca dubia

C. dubia length 28 mm 70 — Cedros cored hardly exceed 20 mm

" " from dist foramen to tubercles at prox end (on cast 20 mm)

same meas on Cedros 12 mm

Humerus 65153/15408 coll'd by Whistler & Jefferson

"Cedros 8" July 1964

Coracoid 65148/15421 ~~same collector but Cedros 4 same data as to site & collectors~~

RHT 1312

July 1964.

prox ulna 65153/15406 Tedford Aug 1965

---

lgth 26.45
8.0 x 9.3 br/depth prox
6.9 depth ex. dist

Puffinus ulna 65153/15404 Tedford 1312 coll'd Aug 1965

" Tarsus 15387/65151 Whistler & Tedford Aug 1965

" " 65151/15386 ditto ↑

" humerus 65153/15404 Tedford Aug 1965

" Tibia 65151/15378 Whistler & Jefferson July 1964

Cedros 2

Photos needed

sulid humerus?

Puffinus tarsus 15384 (prox)
Palaelodus " 15423 (dist)
Cerorhinca humerus 15408 (prox) ✓ 65153
ulna 15406 (prox) 65153
tarsus 15407 (mo) ✓ 65153
coracoid 15421 (65148)
Mancalla scapula carpus
coracoid radius
humerus tarsus 15425
ulna
femur
tibia

Alcidae
Wing bones

	Humerus					Ulna			Carpus	
Cerorhinca	Length	br prox	br dist	br sh	depth sh	gr. length / length to condyle	br sh	depth sh	ext length	Depth prox
Bi 504	67.0	14.0	7.4	3.5	5.6	55.0 / 54.4	3.2	5.0	31.8 / 36.0	9.1
Ptychoramphus			5.5							

actual ~~ct~~ size compared to Uria
with br sternum agreeing

	Ratio humerus to coracoid	ulna to coracoid	carpus to coracoid	femur to cora	tibia to cora	tarsus to cora	Sternum	cora	humerus to	ulna to	carpus	femur to	tib to	tarsus	
Uria	22490	164.3	113.9	124.2	218	99.3									
Mancalla	119.0	51.5	64.2	103.5	158.2	81.7									
auk	180.7	100	77.2	135.1	224	94	at aver 60.1	35.9	67.3	38.0	27.7	48.5	80.5	33.6	21.0
Penguin	94.6	71.7	55.4	117.9	143	46.4	38.3 g ulna	50.0	34.1	25.4	19.7	38.5	51.4	16.6	20.9

Sternum 42.3 = 38.3

Uria	224.	164.3	113.9	124.2	218	99
auk	180.7	100	77.2	135.1	224	94
Manc	119.0	51.5	64.2	103.5	158	81
Penguin	94.6	71.7	55.4	117.9	143	44

Cw

Alcidae leg bones

	Femur			Tibia				—Tarsometatarsus→							
Cepphus col.	length troch. to outer condyle	br dist	least br sh	length to artic	br prox	br dist	br sh mid	gr length	br prox	br 2 condyles	ht dist condyle above end of mid	br mid sh	depth mid sh	Depth mid to int troch sh straight	Dist bet prox & dist foramina
Bi 1173♀	39.6	8.0	3.2	70.4	6.5'	6.4	3.7	36.8	7.1	5.5'	2.8	2.7	2.9	6.3	25.9
Bi 1174♀	40.2	7.3	3.3	71.0	6.1	6.0	3.7	35.9	7.0	5.1	3.0	2.5	2.7	6.1	24.8
Bi 1172♂	40.5'	7.7	3.3	68.0	6.0	6.1	3.5	36.2	7.0	4.8	2.7	2.7	2.7	5.8	24.0
Uria aalge															
Bi 674	50.4	9.8	4.0	91.1	7.5'	8.5'	4.4	40.5'	9.0	6.0	3.5'	3.5	3.2	6.7	26.8
Bi 697	47.3	8.4	4.0	85.4	7.2	8.0	4.1	38.8	8.6	5.8	3.6	3.6	3.0	6.7	24.8
Bi 494	50.0	8.2	4.0	88.8	7.5'	7.7	4.5'	39.0	8.8	5.8	4.0	3.8	3.1	6.8	25.0
Bi 507	49.9	8.8	4.1	89.5'	7.2	7.7	4.5'	39.1	8.4	5.8	3.6	3.6	2.8	6.6	24.5'
Bi 485'	47.7	8.8	3.6	83.5'	7.4	8.3	4.0	36.9	9.0	6.0	3.4	3.5'	3.2	7.3	23.5'
Bi 480	46.8	8.6	4.0	82.4	7.0	7.9	4.2	37.5'	9.0	5.8	3.7	3.9	3.0	6.5'	23.1
Bi 477	48.6	8.5	4.1	85.8	7.2	7.9	4.6	39.6	8.8	6.2	3.3	3.7	3.3	6.3	25.3
	7)3407			7)606.5				7)2714							7)1730 (24.7
	48.6			86.6				38.7							14/33 28/50
Lunda cirrhata															
Bi 696	47.8	8.7	3.7	75.3	7.5'	7.4	3.8	33.4	8.0	6.8	3.1	4.5'	3.3	6.7	19.0
Fratercula corniculata															
Bi 661	43.2	7.7	3.2	67.2	6.7	7.0	3.5'	30.3	7.7	6.2	2.8	3.8	2.8	6.2	16.7
Bi 800	—	—	—	65.7		7.0	3.8	30.6	7.7	6.1	3.1	4.1	3.0	6.2	17.7

Alcidae
Leg Bones

	Femur			Tibia				Tarsus					
Cerorhinca	ext length	dist	br sh	length (entire)	br prox	br dist	br sh	Length	br prox	br 2 dist troch	br sh	depth sh	dist bet foramen
Bi 504.	40.2	7.0	2.9	62.8	5.8	5.7	3.5	29.6	6.5	5.1	4.0	3.0	19.0

alt. tibia 98.5 91.8 83.0

80.8 75.7 72.5 V = 3.8

Comparison of lengths of limb element of M. diegense M. milleri M. cedrosensis

TABLE III

Size of Bones of M. diegense Compared With those from Cedros Island

Elements	Number of specimens	Length (in mm) Max.	Mean	Min.	Ratio of max. to min.	Coefficient of variability
CORACOID					43.5-54 = 124%	
M. diegense	~~6~~ 8 7	54.0	49.4	47.~~7~~ 5	113 %	4.8
M. milleri	9a	43.5	40.0	38.5	112 39-40.5 103%	3.4
Cedros Id.	3	47.5	45.5	43.5	109	4.4
HUMERUS						
M. diegense	7	85.2	76.5	71.0	120	6.6
M. milleri	23b	66.6	62.7	56.4	118	4.0
Cedros Id.	9	80.0	75.0	72.5	117	4.6
ULNA						
M. diegense	4	32.1	~~30.0~~ 29.4	28.9 27.0	112 4	6.3
M. milleri	11	26.6	25.3	23.1	115 23.1-27.6 (120%)	4.1 11
Cedros Id.	12	31.8 9	30.0	28.5 3	112	4.4
RADIUS						
M. diegense	~~3~~ 4 4	31.8	~~30.0~~ 29.4	~~29.6~~ 27.0	~~108~~ 114	~~5.1~~ 5.6 8,25,69
M. milleri	5	25.2 ~~27.0~~	24.6	~~24.0~~	~~104~~	~~4.5~~ 5.1 8,25,64
Cedros Id.	4	31.1	29.3 3	27.3	114	6.6
CARPOMETACARPUS						
M. diegense	5	37.2	35.8	35.0	106	2.2
M. milleri	7	33.2	31.6	29.6	111	~~3.9~~ 4.0
Cedros Id.	4	36.0	35.4	35.0	103	1.4
FEMUR						
M. diegense	5	53.6	52.0	50.0	107	2.7
M. milleri	8	48.6	45.7	42.6	114	4.3
Cedros Id.	2	52.8		52.0		
TIBIOTARSUS					81-98.5 = 121%	
M. diegense	~~6~~ 7	98.5	~~93.7~~ 90.2	91.4 ~~83.0~~ 80.8	~~106~~ 107 121	~~5.4~~ 6.8 ~~3.0~~ 2.6
M. milleri	7 7	77.5	74.9	72.5		
Cedros Id.	1		83.8			
TARSOMETATARSUS						
M. diegense	~~3~~ 4	43.7	~~40.8~~ 39.9	~~38.1~~ 37.7	~~114~~ 116	XXXX 6.8
M. milleri	5	36.1	34.0	31.1	116	6.3
Cedros Id.	3	42.0	39.2	37.3	112	6.~~2~~3
FEMUR (gr.length)						
M. diegense	4	57.0	55.~~3~~ 2	53.8	106	~~2.8~~ 2.5
M. milleri	10	51.2	47.9	44.9	114 ok 114	~~4.0~~ 4.2
M. cedrosensensis	3	56.5	55.4	54.8	102	1.6
Tibia alt. diegense	5 9	98.5	93.7	91.4	108	3.0
milleri	9 9	83.0	76.5	72.5	114	6.9
cedros	1		83.8			

	aver diegensis to max ~~C. monocerata~~	min Uria aalge	Cedros type to max Uria	% min	aver. milleri to max	min ~~[illegible]~~
Coracoid	122%	132%	108	119	100%	107%
humerus	83.5	91.9	78.9	~~87~~	68.4	75.5
ulna	46.0	46.4	46.1	46.5	39.6	40.0
carpo.	91.0	96.9	91.6	97.5	75.6	86.0 ✓
femur	110	118	109	117	95.5	103.5
Tibia	99.5	109	92.5	103	82.6	90.7
Tarsus	98.5	106.3	94.0	104	84.0	90.7

	aver diegensis to aver. Uria aalge	aver milleri to aver Uria aalge	Cedros to min U. aalge	Cedros type to aver. Uria aalge	combined S.D. to aver Uria
Coracoid	122	103.5	116	112 +	128 +
Humerus	87.3	71.5	87	82.6 −	68 −
Ulna to aalge	47.5	40.2	47.5	45.5 −	40 −
Carpus	79.7	71.0	81.5	80.3 −	71 −
Femur	113.1	98.5	116.2	112.5 +	106 −
Tibia	104.0	86.5	101.1	96.7	91 −
Tarsus	103	85.8	100.0	98.4	105 +

TABLE III

Linear Measurements of Mancalla diidgense from San Diego and Cedros Island

	San Diego				Cedros Island					
	No. of bones	Max.	Mean	Min.	LACM 15373	LACM 1284	Total. no. bones	Est max	actual Max.	Min.
Coracoid	(8)	51.7 56.4 ←	49.1	45.0 V 6.6	45.5	....	(1)	51		45.5
Humerus	(7)	80.0 85.2 ←	75.5	71.0 V=6.6	72.4	....	(2)	81	72.7	72.4
✓ Ulna ✓	(4)	32.0	29.8	28.4	29.5	....	✓(10)	31.9 ✓	31.~~9~~ 8	28.~~3~~ 5 V=3.8 Cedros
✓ Radius ✓	(3)	31.7	30.5	29.5	28.0	....	✓(3)	31.5	30.9	28.0
Carpometacarpus	11 ~~(6)~~ 5	37.~~2~~ 1	~~36.1~~ 35.8	35.~~3~~ 0	35.8	....	✓ (4)	39.4 ✓	36.8	35.0 V=2.5
Femur	(5)	53.6	52.7	51.5	52.1	52.8	✓ (2)	58	52.8	52.1
✓ Tibiotarsus	~~(6)~~ 8 98.7	~~94.0~~ 98.7 ←	~~89.8~~ 90.6	82.4 V=6.6	83.9	....	(1)	94		83.9
Tarsometatrrsus	(3)	43.6	39.~~8~~ 5	37.0 V=7.1	....	38.3	✓ (3)	42.0 ✓	42.0	37.3 V=6.9
		~~43.6~~	~~40.3~~	~~38.3~~						

S.D. dif. fr Cedros

	min	max			
— cora	.5 –	11 +	6.2 +		
— Humerus	1.4 –	13 +	7.3		
ulna	~~same~~	.~~5~~ +			
radius	~~.2~~ .5 +	.~~6~~ +			
carpo	same	.3 +			1
			1.20		.6
		.8 +	2.5%		.4
— femur	.6 –	16 + 10	1.20	—	.8
— tibia	1.5 –		1.5%	—	1.6
— tarsus	.3 –	1.6 +	3.5%		

124 coracoid 115 second
120 humerus 113.5 2nd
tomey 120% tibia 114.5 2nd
114% ~~femur~~
118% tarsus
105% carpus
107 Radius
105 carpus
104 femur

coracoid
45
48.6
48.7
49.0
49.7
50.0
50.2
51.7
8) 393.4
49.1

43.6
38.3
37.3
3) 120.2
40.0

S.D
carpus
2660 35.0 ✓
45861 35.3 ✓
2541 37.1 ✓
2542 35.6 ✓
2545 35.9
~~2549 36.5~~
5) 178.9
35.8

III

TABLE IV

Estimated Size Range (in millimeters) of Limb Elements of *Mancalla diegense*, *M. milleri* and *M. cedrosensis*

Element		*M. diegense*				*M. milleri*				*M. cedrosensis*		
		Max.	Mean	Min.		Max.	Mean	Min.		Max.	Mean	Min.
CORACOID												
Length	9	50.1 (54.0)	48.5 (49.1)	47.5	10	43.5	2 40.0	9.0 38.8	3	47.5	45.3	43.3
Breadth below furcular facet		(6.3)	5.8	5.4		5.1	4.9	4.0		6.0		5.2
HUMERUS												
Length	7	80.4 (85.2)	75.2 ~~76.5~~	71.0	25	66.6	62.7	56.4	5	80.0	73.5 ~~77.55~~	69.5
Breadth of proximal end		19.6 (20.3)	3 18.7	17.3		16.4	15.3	14.2		20.1	17.9	17.0
ULNA												
Length	14	32.1	29.4	28.0	16	27.0	25.3	23.6	12	31.7	30.0	28.3
Breadth of proximal cotylae	8	6.6	3 6.4	5.9	8	5.7	5.2	4.5	7	7.2	6.6	6.2
RADIUS												
Length	3	31.8	30.9	29.6	6	26.9	25.1	24.2		21.1	29.3	27.3
Greatest depth of shaft		6.4	66.35	6.3		5.6	4.9	4.6		6.1	5.6	5.4
CARPOMETACARPUS												
Length	7	37.2	35.6	35.0	7	33.2	31.6	29.6		36.0	35.4	34.9
Depth proximal end through metacarpal 1		11.0	10.3	9.7		9.5	9.1	8.8		10.1	10.5	10.2
FEMUR												
Length	5	57.0	55.2	53.8	9	51.1	47.9	44.9 ~~45.0~~		56.5	55.4	54.8
Breadth of distal end		10.7	10.2	9.5		9.3	9.0	8.4		10.8	10.6	10.4
TIBIOTARSUS												
Length	7	93.0 (98.57	89.6 ~~90.2~~	81.0	8	77.5	74.9	72.0		~~.2.5~~	83.9 89.9	~~9.0~~
Breadth of distal end	15	(10.7)	8.9 ~~9.0~~	8.2		7.9	7.2	6.5 ~~6.8~~		9.5	9.2	9.0
TARSOMETATARSUS	5	43.6	39.9	~~38.0~~ 37.9	5	36.0	34.0	31.1		43.0	39.2	37.3
Breadth of proximal end		10.7	9.6	8.7		8.4	8.1	7.8	5	10.9	0 10.1	8 9.9

Cedrus radius

31.1
30.9
28.1
27.3
4)117.4
29.3

967.21
954.81
789.61
745.29
3456.92
3445.69
3)11.23
3.74

6.6
29.3)1.933908
1758
1759

1174
1174
4696
8218
1174
1174
4)1378276
344569

Cedrus humerus est from

prox br.		prox	head
20.0	–	80 est	16.3
long 18.5?	–	72.5	14.7
17.9	–	72.4	14.7
17.8	–	72.2	14.6
17.2	–	69.5 est	14.1

5)366.6
73.3

80.0
70.0
72.5
72.4
72.2
5)367.1
73.4

80
72.5
72.4
72.2
70.0
5)367.1
73.4

Cedrus tarsus

Cedrus ulna

15372	31.7	1004.89
15398	31.7	1004.89
15444	31.3	979.69
15595	31.0	961.00
15371	30.6	936.36
15396	30.3	918.09
15427	29.9	894.01
15415	29.4	864.36
15399	29.4	864.36
15373	29.2	852.64
15394	28.5	812.25
15412	28.3	800.89

42
38.3
37.3
3)117.6
39.2

1744.00
1466.89
1391.29
4602.18
4609.92
2)12.26
6.13

6.3
39.2)2475.884
2352
1238
1176

81.0
78.5
2.5
78.5
1.2
79.7
81.0
1.2
79.8

1176
1176
7056
8232
1176
1176
3)1382976
460992

Ulna S D aug 25, 1969

M 29.0

Total 5 Large 145.2

M 25.3 14 Small 354.5

19)4997
26.3

119
114
57

4229.34
8991.11
13220.45
1314211
18)78,34(4,352
72
63
54
94
90
40

7.8
263)2085665
1841
2346
2104
2426

499.7
499.7
34979
44973
44973
19988
19)24970009(1314211
19
59
57
27
19
80
76
40
38
20
19
19

1452
1452
2904
7260
5808
1452
5)21083.04(4216,60
20
10
10
8
~~2~~
33 0
30
30

4229.34
4216.60
4)12.74
3.18
6.1
290)1.78,3,255
1740
~~3~~432

3.8
3.8
304
114
144

3.84
3.84
1556
3072
1152
147456

3.83
3.83
1149
3064
1149
146689

3545
354.5
17725
14180
17725
10635
4)1256 7025(8976.44
112
136
126
107
98
90
84
62
56
65

8991.11
8976.44
13)14.67
1.12
~~8~~

4.1
253)1.05,8,301
1012
463

20863
20863
62589
125178
166904
41726
435264769

2086
2086
12516
16688
4172
4351396

2087
2087
14609
16696
4174
4355569

7.9
263)208,63
1841
2453
2367
860

other S.D.

Published San Diego Mancalla	vs. Cedros Id. #1296=LACM 15323	Other Cedros (#, specs.)
Coracoid		
48,7 51,7 } length (middle)	43,2 length (middle) 45,5 gr. length (int)	
17,5 18,3 } ht prox part	15,6 ht. prox. part 7,3 br 5,3 ht. art ly } prox. part	
Humerus		
56,4 63,7 65,0 66,6 } length to int. condyle	72,4 length to int. condyle	72.7 (LACM 15367) br prox 18.5
14.2, 15.7, 15.9, 18.5, br. prox. br prox 15,25 18,45 18,7 19,8	17,9	17,0 – 20,2 (5) 18.6 av.
Ulna		
23,3 24,4 31,6 } length to intercotylar ridge	29,5	~~28.5 – 31.8~~ 28.9 – 33.4 (11) aver. 30.2
Radius		
27.0 outer length	28,0	
25.3 inner "	26,6	
Scapula		
11.0 11.3 13.0 } br. artic end		
Carpometacarpus		
29,8 31,7 35,2 } gr. length	35,8	33.4 – 35.8 (4) 34.8 aver.
Femur		
50,4 54,2 type [illegible] 56,3 } gr. length	54,6	55.65 left RHT 1284 56.2 R "
Tibiotarsus		
72,8 74,5 91,4 92,7 } length to artic.	83,9	
Tarsometatarsus	42.0	37.3
43.7 gr length 38.3 36.0 unpublished 31.1 35.8 34.6 } 32.5		

	Cedros 1294	San Diego Largest 5		
Tibia				
Length	83,9	91,4-98,7	80,8-82,2	72,0-77,2
Br. dist	9,4	8,7-10,6	8,6-8,9	6,9-7,3
Depth int	8,8	8,8-9,8	8,6-8,9	7,1-8,0
Depth ext	8,7	8,8-10,0	7,9-8,4	7,0-7,7

TABLE III

Linear Measurements of Specimens Assigned to Mancalla diegense from San Diego and [Cedros Island — now = M. cedrosensis] n. sp. as published

	San Diego			Cedros Island		
	No. of Bones	Max.	Min.	No. of Bones	Max.	Min.
Coracoid	(8)	56.0	45.0	(1)		45.5*
Humerus	(7)	85.2	71.0	(2)	72.7	72.4*
Ulna	(4)	32.0	28.5	(10)	31.9	28.5
Radius	(~~3~~ 4)	31.7	29.5	(3)	30.9	~~28.0*~~ 27.3
Carpometacarpus	(5)	37.1	35.0	(4)	36.8	35.0
Femur	(5)	53.6	51.5	(2)	52.8	52.1*
Tibiotarsus	(8)	98.7	82.4	(1)		83.9*
Tarsometatarsus	(3)	43.6	37.0	(3)	42.0	37.3

~~*The starred measurements all refer to Specimen no. 15373, and are of one individual. The ulna and carpometacarpus are of~~ ~~xx~~~~other individuals,of lesser size than no. 15373. There was no tarsometatarsus found with no. 15373.~~

*The starred minimum measurements are from one individual (LACM no. 15373). ~~Thexulnaxofx15373xmeasurex~~ The ulna and carpometacarpus of 15373 measure slightly greater than the minimum of the sample (ulna 29.5 mm., radius 29.0 carpometacarpus 35.8 mm.). est tarsus 37.8 based on 1284 Ratio femur/tarsus (1284 femur = 52.8, tarsus 38.3) There was no tarsometatarsus with this specimen. Cedros specimen LACM 1284 includes associated femur & tarsometatarsus measuring 52.8 mm and 38.3 mm respectively.

			~~Mean~~ Mean M diegense using max		using next to max
			85%	or	85.2
15373	Ratio humerus to tibia	86.5%	14~~5~~3	or	143
	" to femur	139%	65	or	65
	" coracoid to humerus	63.0%	58.5	or	59.5
	" femur to tibia	62.3%	94.4		93.3
	" coracoid to femur	87.3%			

	humerus coracoid	ulna to humerus	carpus to humerus	femur to pelvis br.	tibia to femur	tarsus to femur	tarsus to tibia	coracoid to sternum	tars to pelvis	~~Carp~~ to cora / ulna to cora
Mancalla	119.0^{b}	43.2^{a}	53.8^{c}	162.0	152.9	78.9^{c}	47.4^{d} ~~51.6~~	131.0^{c}	128.0	64.3^{b} / 51.4
Pinguinus Mt.	176.0^{c}	57.6^{b}	44.5^{a}	232.0	171.0	70.5^{b}	41.2^{b}	92.4^{a}	144.0	78.3^{c} / 101.3
Uria av.	224.0^{d}	73.4^{c}	50.7^{b}	208.2	179.0	80.0^{d}	44.6^{a}	102.0^{b}	166.0	103.9^{d} / 164.3
Spheniscus	92.7^{a}	76.4^{d}	59.5^{d}	182.8	138.0	42.3^{a}	30.6^{a}	132.0^{d}	225	55.1^{a} / 90.7

Coracoid Pinguinus smallest, Spheniscus largest
Humerus Spheniscus shortest, Uria largest
Ulna Mancalla " Uria "
Carpus Spheniscus " Uria " rel. to cora
Carpus Pinguinus " Spheniscus " " " hum.

	Hum + ulna + carpus	wing lgth rel to cora	wing lgth rel to sternum		fem + tib + tarsus	~~D~~ wing lgth leg lgth	leg lgth to pelvis br.
Mancalla	117.8 mm ^{a}	230.0% ^{b}	3000^{b}		172.5		
Auk	205.8^{d}	350.0% ^{c}	3200^{c}		261.7		
Murre	196.4^{c}	580.0% ^{d}	5100^{d}		174.2		
Penguin	123.0^{b}	210.0% ^{a}	2900^{a}		165.8		

	hum % of wing	ulna % of wing	carpus % of wing		fem % of leg	tib % of leg	tarsus % of leg
Mancalla	50.7	22.0	27.3		30.1	46.0	23.8
Auk	49.5	28.5	22.0		29.4	50.2	20.6
Murre	44.6	32.7	22.7		27.8	49.7	22.2
Penguin	42.4	32.4	25.2		35.6	49.3	15.1

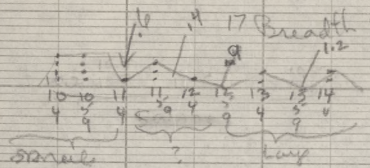
	Uria aalge max	mean	min	Type cedrosensis	Range Cedrosensis max	mean	min	Range M. diegense max	mean	min ✓	Range M. milleri ✓ max	mean	min	
coracoid	40.0	38.7?	37.2	43.2	(3) 47.5	45.3	43.2	54	49.1	47.5	43.5	40.0	38.5	cora
Humerus	674 91.4	87.7	480 83.2	72.4	(5) 80.0	73.5	69.5	85.2	76.5	71.0	66.6	62.7	56.4	humo
ulna to condyle	494 674 ~~(68.2 67.6)~~ 68.2 | 67.6	65.0	480 62.3	29.5	(12) 31.7	30.0	28.3	32.1	29.4	28.0	27.0	25.3	23.6	ulna
carpo. ext.	674 46.7 (494 45.6) 6 specimens	44.6	485 480 43.3 (44.0)	35.8	(4) 36.0	35.4	34.9	37.2	35.6	35.0	33.2	31.6	29.6	carpus
femur	674 50.4 (494 50)	48.6	480 46.8	54.7	(3) 56.5	55.4	54.7	57.0	55.2	53.8	51.1	47.9	45.0	femur
tibia	674 91.1	86.6	480 82.4	83.9	—	83.9	—	98.5	90.2	81.0	77.5	74.9	72.0	tibia
tarsus	674 40.5	38.7	485 480 36.9 (37.5)	38.0?	(3) 42.2	39.2	37.3	43.6	39.9	38.0	36.0	34.0	31.1	tarsus

Ratio Mancalla to Uria aalge

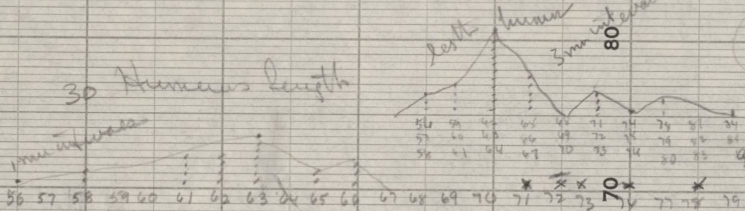
	Type cedrosensis to aver. Uria	to #480 (min.)	~~aver~~ cedrosensis to aver Uria	to aver. diegense	aver. diegense to aver Uria	aver. milleri to aver Uria	Puf. S.D. to Uria	Type cedrosensis to min diegense	to aver diegense	to max milleri	to aver
cora	111%	116%	117%	92.3%	★ 127.1% nearest to chart puf's	103.5	128	91.0	87.7	99.5	108
hum	82.5%	87%	83.9%	96.0%	87.0%	★ 71.5	68	102	94.3 ~4	108.5	115.1
ulna	45.4	47.4	46.3%	✓ 102.?%	45.3	★ 39.0	40	105.5	✓ 100.2	109.1	111.5
carpus	80.2	to min (82.9) to 480 81.5	79.3%	✓ 99.4%	80	★ 70.9	71	102.1	✓ 100	107.8	113.2
femur	112.1	116.9	113.9%	✓ 100.1%	★ 103.2	100.5	106	101.5	✓ 99.3	107.0	114
tibia	96.7	101.9	no aver %	no aver cedro.	103.9	86.3	92	103.6	92.9 ~7%	107.1	112
tarsus	98.3 (?) ~~103(?)~~	485 103 (480? 101.2)?	101.2%	98.5	★ 103.0	88.0	105	100	93.3 ~5	102.9	112

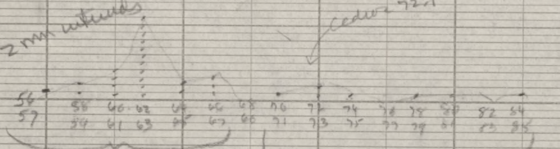
Scapula

17 Breadth prox end



30 Humerus length



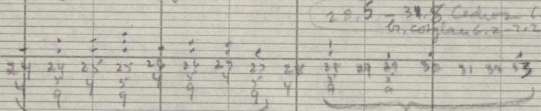


Small
all have
br. prox under
17.9

Large
all have br. prox
over 18.2 mm

20 Ulna length
from intercotylar ridge to internal condyle

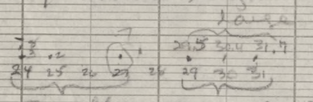
28.5 – 34.8 Cedros (12 bones)
Br. cotylar 6.2 – 7.2



Small
Br cotylar 4.5-5.7

Large
Br cotylar 5.4 - 6.6

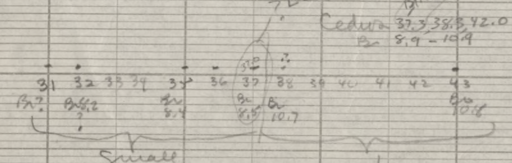
7 Radius length



Cedros 29.0, 30.9, 31.1

9 Tarsus length

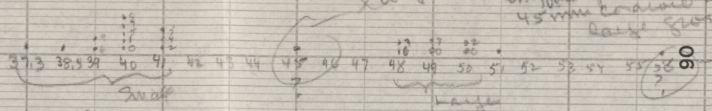
Cedros 37.3, 38.3, 42.0
Br 8.9 - 10.9



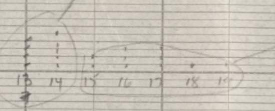
Coracoid Length

cedros 45.5

large

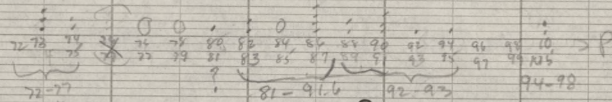


Ratio of ht of
tip of furcular facet
to br. of facet puts the
45 mm coracoid in the
large group

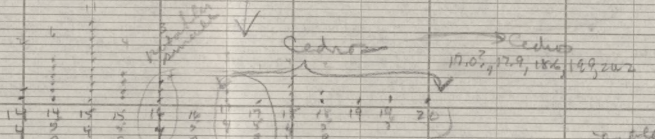


coracoid
scap facet & head

Tibia dista



30 Humerus prox end

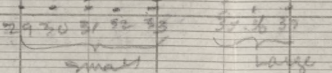


all short
where length
available

no length for these
in S.D.

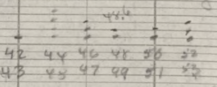
all long
where length available

11 Carpometacarpus
Length ext. crest to dist. end Mc 2



Cedros
35.0, 36.0, 36.2, 36.8

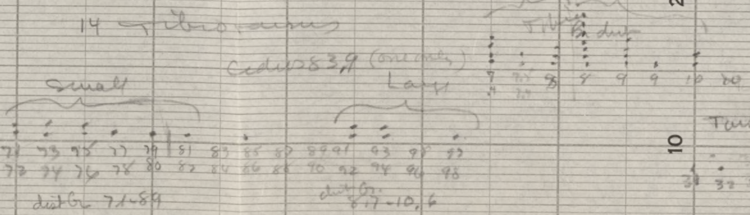
10 Femur intercondylar length (no ests)



Cedros 52.1, 52.8

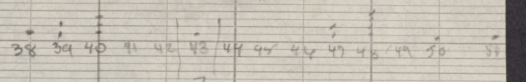
14 Tibiotarsus

Cedros 83.9 (one only)

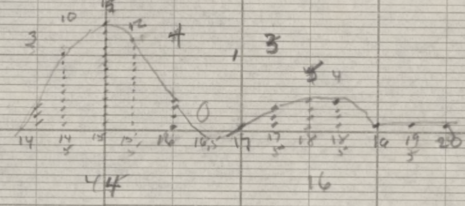


The facet is
relatively higher
at tip in the small
form

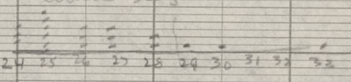
Coracoids omitting poorly formed
meas. made tips above & below



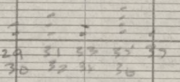
40 humerus
> prox from other lots
up to 1965



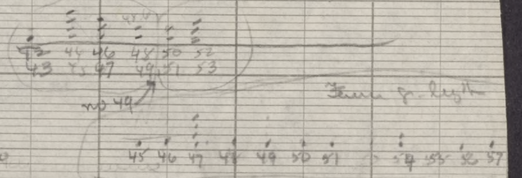
Ulna length



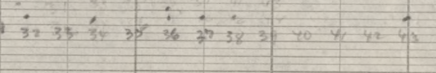
carpus



15 Femur intercondylar with
est'd specimens added



Tarsus



HEWLETT-PACKARD/MOSELEY DIVISION 9280-0105

Measurements of jacketed specimens

Uria min		type 153773	15425	23239	15410	Cedros Uria 480	474
37.2	Coracoid	✓43.2			R L 48.0	37.2	40.0
83.3	Humerus	✓72.4			✓	83.3	91.7
62.5	ulna	✓✓29.5				63.5	69.0
	radius	✓28.1					
ext 44.0	carpo.	✓35.8			diseased ✓33.4 ap.	36.8	39.2
46.7	femur	✓54.7	prox	55.0? R+L	✓	46.7	50.3
82.6	tibia	✓83.9	prox	dist		82.6	90.7
37.5	tarsus	prox 10.2 38.0 est	37.3 prox 10.0	38.3		37.5	40.5

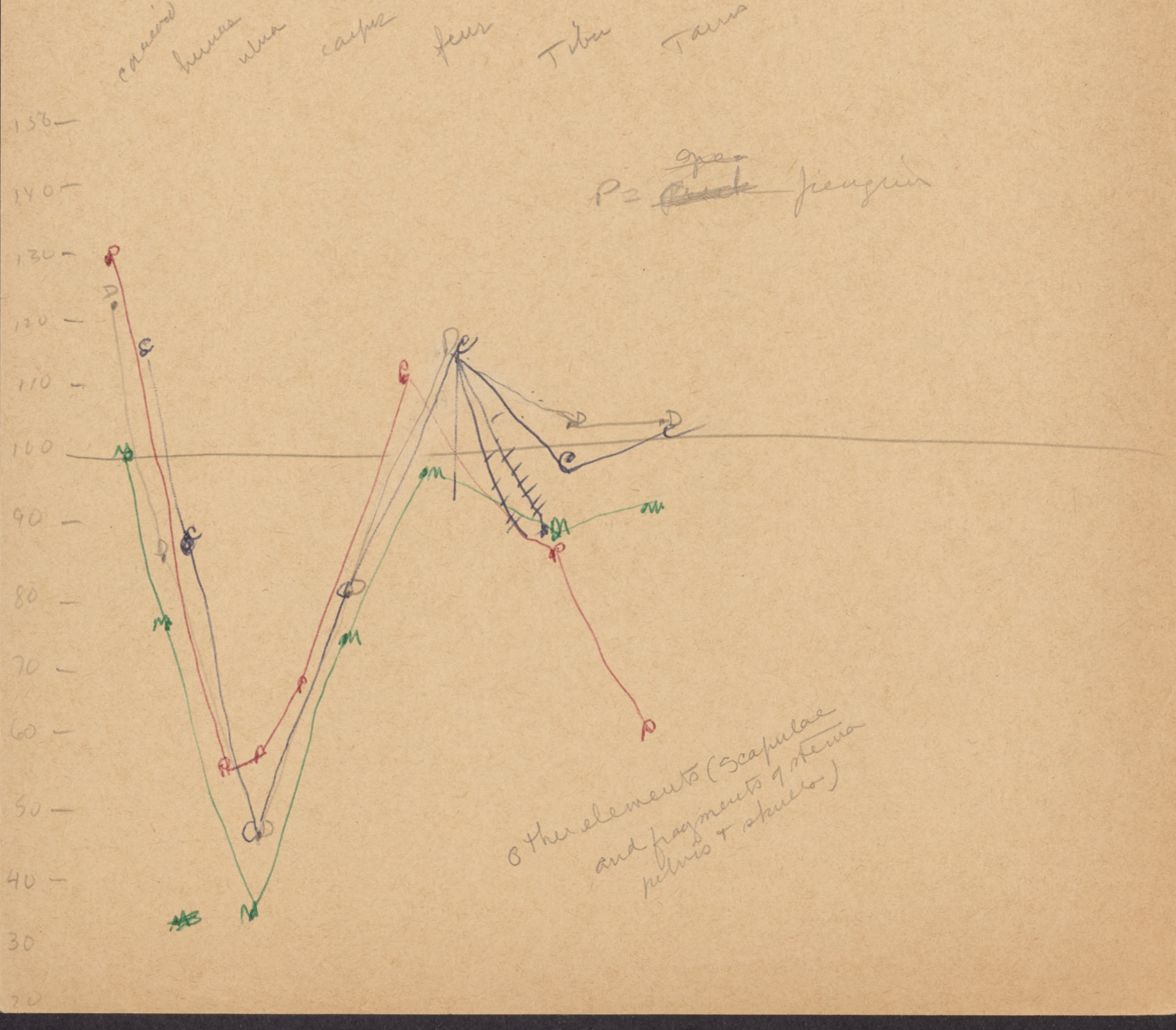
Cedros

			Ratio in M. diegense mills	Uria 480	474
Coracoid	/ humerus	59.6 %	63.5 64.4 66.9 65.4 64.0 68.5	44.8 %	43.6 %
femur	/ humerus	75.6 %		56.2	54.6
tarsus	/ femur	69.6 %		80.2	80.7
tibia	/ femur		123/133/150 151/156/160	76.3	75.4
Ulna	/ humerus	40.7 %			

Cedros /	Uria 480 min	474 max	Cedros to ave M. diegense	to 474	Cedros to ave M. [illegible]	to 480
coracoid / coracoid	116 %	108 % ave 112 % ✓	88.1	123	108	106.5
humerus / humerus	87	79 ave 83	94.4-.5	83.3	115	75.4
ulna / ulna	47.5	43.0 ave 45 ✓	100.0	42.5	118	40.0
			100.0	88.8	113.5	86
carpo / carpo	97.5	91.5 ave 94.5				
femur / femur	117	109 ave 113 % ✓	99	110	104	102.5
tibia / tibia	101.2	92.4 ave 98	93	99.5	112	90.7
~~cora / cora~~			95.5	98.7	111	90.7
tars / tars	101.5	94.0 ave 94				

Uria aalge	max	mean est from the max + min	min	min cedrus	mean kieg	/ M. uria cedrus	mean millen	/ M. uria cedrus mean
coracoid	40.0	38.6	37.2	43.2	123%	102	100%	117%
humerus	91.5	87.7	83.2	72.4	87%	82.5	78	88%
ulna 7	68.2	65.0	62.3	29.5	45	45	39	46.2
carpus 6	46.7	44.6	43.3	35.8	80	80	71	79
femur 7	50.4	48.6	46.8	54.6	113	112	98.5	113
tibia 7	91.1	86.6	82.4	83.9	104	98-	86	—
tarsus	40.5	38.7	36.9	38.9	103	100	88	101

mean diegense ÷ mean Uria



Cedrus ulua

30.2	912.04
31.6	998.56
31.3	979.69
31.6	998.56
29.7	882.09
31.0	961.00
28.3	800.89
28.3	800.89
29.5	870.25
30.0	900.00
29.5	870.25
31.0	961.00

12)362.0
30.1

10935.22
10920.33
11)14.89
1.3536

Square
1092.033
12)13104400
12
11.0
108
24
24
046

4.4
30.1)132.36
1204
1496

Cedrus taurus

~~362~~

42.0	1764.00
38.4	1474.56
37.3	1391.29

3)117.7
39.2

4729.85
4617.76
2)12.09
6.04 = σ²

1177
1177
8239
8239
1177
1177
3)1385329
461776

2 2 2.457641
6.2
39.2)245.7641
2352
1056
784
272

Cd tao ulua 5

30.0	900.00
29.0	841.00
30.0	900.00
25.6	655.36
29.9	894.01

5)144.5
28.9

)4190.37
4176.05
4)34.32
8.58 = σ²

1445
1445
7225
5780
5780
1445
5)2088025
417605

144.5
− 25.6
4)118.9
29.7

4190.37
655.36
3535.01
3534.27
3).74
.247

V with 25.6
10.4
289)2929.164
289
1391
145

1.7 V without small 25.6
297.)49.7.
297
2000

2.929164 = σ²

1189
1189
10691
9512
1189
1189
4)1413711
353427

157
157
1099
785
157
.024649

.49
.49
441
196
.2401

2495
2495
12475
22455
4990
4990
6225025

1495
1495
2475
4455
1980
245025

July 16, 1960 Carpometacarpus

37.1
35.9 360
35.6
35.3
35.0
5)1789
35.8

1376.41
1288.81
1267.36
1246.09
1225.00
6403.67
640104
4)2,63
.657 = s²

178.9
178.4
16101
14312
12523
1789
5)32005,21 (640104
30
20
20
05
5
21

35.8
5)179
15
29
25
40

.81
.81
81
648
.6561

82
82
164
656
.6724

s = .811
2.2
358)181,1,
716
950

2,092845
1
334)209,2,845

178.9
189.0
11)3679 (33.4
33
37
33
49

6403.67
5962.22
1236589
1232208
10)4384 = 4.38
11)1354240
11
25
22
35
33
24
22
22
4

33.2 –
32.8 –
~~32.2~~
31.4 –
31.0 –
30.7 –
29.7 –
7)2213
31.6

1102.24
1075.84
~~1036.84~~
998.56
961.00
942.49
882.09
6999.06
−698992
6)9.14
1.52 = s²

221.2
221.2
4424
2212
4424
4424
7)489294 4
69899 2

178.9
221.2
12)4001
33.3

4001
4001
4001
16004
12)16008001
1334000

6403.67
6999.06
13402.53
−1334000
11)62.73 15.70 = s²
55
77

2,387447 = s
7.1
333)238,7,467
2331
564

6)1890
31.5
s = 1.232883
3.9
316)123,2,883
948
2848
2844

6999.06
− 1036.84
5962 22
5953.50
5)8.72
1.70

Combined M = 33.3
" V = 7.1

189
185

1,30384
4.1
31.5)130,38
1270
338

5953
6)35721
30
57
54
32
30
21
18
30

Cedus Radius

27.3
30.9
31.1
28.0
4)117.3
29.3

745.29
954.81
967.21
784.00
3451.31
3439.82
3)11.49
3.83

1173
1173
3519
8211
1173
1173
4)13759.29
343982

3.4
34
136
102
115.6

3.38
338
2704
1014
1014
114244

2 = 3.39 s = 1.957039

293)339.0

4.6
293)1957039
1758
1990
1758
2323

Cedus caupo.

36.7
36.0
35.8
35.0
4)143.5
35.8

1346.89
1296.00
1281.64
1225.00
5232.13
522006
3)1207
4.02 = 2

1445
1445
7225
5780
1445
2095.25(523.80
4)20
8
15
12
32
32

1445
1445
7225
5780
5780
1445
2088025(522006
4)2088025
~~2022006~~
8
8
8
8
025

2 = 2.004994
5.56
36)200.4994
180
204
180
249
216

Cedros

The greater part of the avian remains belong ~~to a single species – the belonging~~ to the extinct genus of flightless auk Mancalla. In addition to separate elements, there ~~were~~ ~~specimens~~ individuals were found in which ~~bones of~~ several skeletal elements were found assoc

4 45144/23939 R & L femur
L tibia
L tarsus

4 65144/15425 L prox femur
L prox tibia
R tarsus
? dist tibia

12 65147/15373 R & L ulnae
Humerus
R coracoid
L carpus & dist R
R & L femur
comp tibia
dist "
Radius & frag of the skull
prox end tarsus

7 65150/15410 carpometacarpus
R & L coracoids
R & L scapulae
sternum crushed
furcula
four radius'

~~Four~~ associated partial skeletons of this bird were found and approximately 40 other ~~single~~ wing & leg bones, with a few vertebrae and one ~~partial skull~~ ~~beak~~ upper mandible.

The preponderance of avian material is assignable to the flightless auk, *Mancalla*

Oct 26, 1970
Copied 11, 13, 70
colls by Tedford 1965
RHT 1296

Mancalla cedrosensis new species

Holotype: Associated skeletal elements of one individual, LACM 15373, including essentially complete right scapula, coracoid, humerus, ulna, femur and tibiotarsus, and left ulna, radius and carpometacarpus; also including distal ends of right radius, right carpometacarpus and left tibiotarsus, extreme tip of proximal end of right tarsometatarsus, left femur with broken distal end and several fragmentary thoracic and cervical vertebrae. collected by R. Tedford, 1965 (RHT field no. 1296)

Locality: LACM locality 65147, ~~top of Unit 12~~, east branch Arroyo Esqueletos, approximately 10 feet above Miocene/Pliocene contact; north side Valle Blanca, ½ miles so. cannery village, southeast corner Cedros Island, Baja California.

Formation and Age: ~~Salada~~ Almejas Formation, early Pliocene.

Referred Material: Three associated skeletons: LACM 15425 from LACM locality 65144 (Arroyo Esqueletos, ~~Cedros Island~~ approx 25 ft above Mio/Plio contact), including proximal ends of left femur and tibiotarsus, distal end of right tibiotarsus, complete right tarsometatarsus (approx size of type which is incomplete), fragment of pelvis, and vertebrae; LACM 23739, also from LACM locality 65144, including right and left femora, left tibiotarsus (distal end) and complete left tarsometatarsus; and LACM 15410 from locality 65150 (Arroyo Tiberon, ~~Cedros Island~~ approx 70 ft above Mio Plio contact) including right and left scapulae and coracoids, a furcula, crushed sternum, and a carpometacarpus. Also unassociated elements from all localities, consisting of a rostrum, 2 scapulae, 1 coracoid, 10 humeri, 14 ulnae, 3 radii, 5 carpometacarpi, 1 femur, 4 tibiotarsi, 6 tarsometatarsi and 3 vertebrae.

at 1st considered as possible paratype RHT 1297

RHT 1294

RHT 1310

Diagnosis: Humerus with internal contour from shaft through bicipital crest broadly and gradually curved; area below head, between pectoral attachment and pneumatic fossa oval and deeply depressed. Coracoid relatively short and heavy (ratio of breadth

Olecranon of ulna extending beyond shaft in ulnar contour

Length of Process of Mt of carpometac more than 44 percent of total length of bone.

Mancalla

10.26/70 p. 2a

below furcular facet to length more than 12 per cent; ratio of length of coracoid to length of humerus 59 per cent; tip of furcular facet blunt but up-turned. Femur with obturator ridge relatively short, straight in internal contour, and with well-marked depression internal to ridge. Tibiotarsus with distal internal ligamental prominence a distinct, rounded papilla below the level of the proximal edge of the internal condyle; external ligamental prominence negligible. ~~Tarsometatarsus flared proximally and distally, shaft depressed anteriorly with bordering ridges~~ sharply defined.

Stet

Comparisons: In all qualitative characters separating M. diegense and M. milleri from M. californiensis, M. cedrosensis is closer to M. diegense and M. milleri (see Howard, 1970, Table I).

In the qualitative characters that distinguish M. diegense and M. milleri (Howard, op. cit, Table IV), M. cedrosensis resembles M. diegense in the projecting anteror edge of the furcular facet of the coracoid and in the proximal flare of the tarsometatarsus, but the borders of the metatarsal shaft are more sharply defined. In the femur, the depth of the depression internal to the obturator ridge resembles the conditionin M. milleri, but the ridge is shorter. In the tibiotarsus the distal internal ligamental prominence is much more prominent than in either M. diegense or M. milleri, but seemingly is closer to the latter in placement below the level of the proximal border of the condyle; the poor preservation of the San Diego specimens somewhat ~~xxxxxxx~~ obscures the true situation of the prominence; the external ligamental prominence is negligible as in M. milleri.

¶ M. cedrosensis is distinct from both M. diegense and M. Milleri in the contour of the humerus from shaft to bicipital crest, being more broadly and gradually rounded even than in M. milleri; also distinct is the oval shape of the area of origin of the external head of the triceps below the humeral head; in both California species this area is broader and of generally angular contour at the junction of the head and pectoral attachment. Distinction is noted also in the ulna in which the olecranon is more prominently developed and extends slightly beyond the shaft in ulnar contour, ~~and the depression adjacent to the olecranon, internally, is deeper even than in M. milleri.~~ Both [illegible] as in M. diegense, though allowance should be made for the poor preservation of the S. D. bones [illegible] M. milleri [illegible] equals M. cedrosensis [illegible]

The type of M. cedrosensis provides for the first time an accurate guide to the proportionate dimensions of the skeleton in a species of Mancalla. It is 12-16 per cent longer than the average for M. milleri in all represented elements except the coracoid; it is only 8 per cent longer in this element. It is essentially equal to the

On the "excavation" the "proc" of M 1 is relatively deeper [illegible] length of the element

coracoid
right 35.3 - 15.4
37.0 15.2
35.4 15.2
35.3 15.2
476 1.05
15.25

35.5 15.9
34.8 15.8
— 15.5
32.8 14.8 3468
29.7 12.6 15.6
2)270

M. cedrosense
P3

average of M. diegense in length of ulna, carpometacarpus and femur, 5-7 per cent shorter in humerus, tibiotarsus and, probably, tarsometatarsus (this element is incomplete in the type), and 12 per cent shorter in the coracoid. Compared with the 59 per cent ratio of length of coracoid to length of humerus in the type of M. cedrosensie, the ratio in both M. diegense and M. milleri is 64 per cent based on averages.

Compared with a small specimen of Uria aalge (LACM Bi 480, which is of minimum size for the species in most elements), the fossil shows greatest difference in longer (116 per cent) coracoid and femur and shorter humerus (87 per cent), carpometacarpus (81.5 per cent) and ulna (47.5 per cent). The tibiotarsus is slightly longer (102 per cent); the tarsometatarsus in the type is incomplete, but judging from the size range in the two species, the tarsometatarsus would be slightly longer in the fossil (possibly 101 per cent). These proportions differ somewhat from those computed for the San Diego Mancalla material (Miller and Howard, 1949:207) which, we now know, were based on two species (Howard, 1970). With unequal representation of the large and small species, these ptrior figures overemphasize the latbge size of the coracoid (at 128 per cent) and the small size of the humerus,~~xx~~ carpometacarpus and uln (at 68, 71 and 40 per cent respectively) and underestimate the length of the femur (106 per cent).

Measurements of type, LACM 15373: Humerus, length to internal condyle 72.4 mm; breadth of proximal end 17.9 mm; breadth of distal end 7.2 mm; length from head to distal edge of deltoid crest 48.8 mm. Scapula, bredth of proximal end 12.6 mm. Coracoid, length lateral to furcular facet and internal distal angle......

Namalla p. 4
10.28.70

43.2 mm, breadth of furcular facet 7.3 mm, length from below scapular facet to head 15.6 mm, least breadth of shaft below procoracoid 5.3 mm; ulna length from intercotylar ridge to internal condyle 29.5 mm, depth of proximal end through olecranon 9.5 mm, breadth across proximal cotylae 6.5 mm, breadth of shaft at middle 4.2 mm, depth of shaft 6.2 mm; radius, greatest length 29.0 mm; carpometacarpus length to end of metacarpal 2 35.8 mm, length of process of metacarpal 1 16.0 mm (approximately); femur greatest length 54.7 mm, depth through trochanter and obturator ridge 9.2 mm. breatest breadth of distal end, 10.6 mm; tibiotarsus, length from proximal articular surface 83.9 mm, breadth of distal end 9.4 mm, depth of distal end 8.8 mm; tarsometatarsus breadth of proximal ~~end~~ end 10.2 mm.

Proportions (in %): coracoid/humerus 63%; ulna/coracoid 65%;
ulna/humerus 41%; carpometacarpus/humerus 49.5%;
femur/humerus 72%; femur/tibiotarsus 62%;

[in Tedford # 1284 (Jac M no 15425?) assoc. femur + tarsometatarsus (38.3 mm)
have tarsus/femur ratio of 73%]

Copied

below furcular facet to length more than 12 per cent; ratio of length of coracoid to length of humerus ~~60~~ 59 per cent); tip of furcular facet blunt but up-turned. Femur with obturator ridge relatively short, and straight in internal contour, and with well-marked depression internal to ridge. Tibiotarsus ~~relatively short (ratio of tibiotarsus to femur 153 per cent);~~ with distal internal ligamental prominence a distinct, rounded papilla below level of proximal edge of internal condyle; external ligamental prominence negligible. Tarsometatarsus flared proximally and distally, shaft depressed anteriorly, with bordering ridges sharply defined.

Comparisons: M. cedrosensis averages 10-17 per cent larger than M. milleri throughout its skeleton, and in most elements its size range overlaps that of M. diegense. The coracoid, however, is a shorter, stockier bone (see Table

In all qualitative characters separating M. diegense and M. milleri from M. californiensis, M. cedrosensis is closer to M. diegense and M. milleri.

In the qualitative characters that distinguish M. diegense and M. milleri, M. cedrosensis resembles M. diegense in the projecting anterior edge of the furcular facet of the coracoid and in the proximal flare of the tarsometatarsus, but the borders of the metatarsal shaft are more sharply defined. It resembles M. milleri in the depth of the depression internal to the obturator ridge of the femur, but the ridge is shorter. In the tibiotarsus Ub tge tubuitarsys the distal internal ligamental prominence is much more prominent than in either M. diegense or M. milleri, but seemingly is closer to the latter in placement below the level of the proximal border of the condyle; the poor preservation of the San Diego specimens somewhat conceals the true situation of the prominence; the external ligamental prominence is negligible as in M. milleri. M. cedrosensis is distinct

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TABLE ~~IV~~ III

Estimated Size Range (in millimeters) ~~of Limb Elements of~~ of specimens of

Mancalla diegense, and M. milleri ~~and M. cedrosensis~~

13.5
14.2
13.5
3) 41.2
13.7
mean 13.7

Ratio type cedros. to M. diegense

Element	M. diegense Max.	M. diegense Mean	M. diegense Min.		M. milleri Max.	M. milleri Mean	M. milleri Min.		M. cedrosensis Max.	M. cedrosensis Mean	M. cedrosensis Min.	Type
Scapula	14.4	13.5	12.7	93.3%	11.8	10.9	10.3		15410 13.5	type 12.6 min	max 15401 14.2	12.6
CORACOID brachial to int. tip of sternal facet												
Length	54.0	49.1	47.5	91.9%	43.5	40.0	38.5	2 or 3	47.5	45.3 cast 15400	43.2	43.2
Breadth below furcular facet	6.3	5.8	5.4		5.1	4.9	4.0		6.0		5.2	5.3
HUMERUS												
Length	85.2	76.5	71.0	94.5%	66.6	62.7	56.4	5	80.0	73.55	69.5	72.4
Breadth of proximal end	20.3	18.7	17.3		16.4	15.3	14.2		20.1	17.9	17.0	17.9
ULNA												
Length	32.1	29.4	28.0	100%	27.0	25.3	23.6	12	31.7	30.0	28.3	29.5 R 29.8 L
Breadth of proximal cotylae	6.6	6.4	5.9		5.7	5.2	4.5		7.2	6.6	6.2	6.5 R+L
RADIUS												
Length	31.8	30.9	29.6	90.8%	26.9	25.1	24.2	4	~~21.1~~ 31.1	29.3	27.3	28.1
Greatest depth of shaft	6.4	6.35	6.3		5.6	4.9	4.6		6.1	5.6	5.4	5.7
CARPOMETACARPUS												
Length	37.2	35.6	35.0	100%	33.2	31.6	29.6	4	36.0	35.4	34.9	35.7
Depth proximal end through metacarpal 1	11.0	10.3	9.7		9.5	9.1	8.8		11.1	10.5	10.2	broken
Length thr. proximal M I	15.5	15.3	15.2		14.5		12.6		16.0	15.6	15.4	16.0
FEMUR												
Length	57.0	55.2	53.8	99%	51.1	47.9	45.0	3	56.5	55.4	54.8	54.7
Breadth of distal end	~~10.7~~ 11.1	10.2	9.57		9.3	9.0	8.4		10.8	10.6	10.4	10.6
TIBIOTARSUS												
Length	98.5	90.2	81.0	93%	77.5	74.9	72.0	1	5	83.9	...0	83.9
Breadth of distal end	10.7	9.0	8.2		7.9	7.2	6.5		9.5	9.2	9.0	9.4
TARSOMETATARSUS	43.6	39.9	38.0		36.0	34.0	31.1	3	43.0 2	39.2	37.3	37.3
Breadth of proximal end	10.7	9.6	8.7		8.4	8.0	7.2		10.9	10.3	9.9	recent fracture 10.2 15373

TABLE V

Size Range(in millimeters) of Mancalla cedrosensis

add → M. diegense and M. milleri

~~and Measurements of Type Elements~~

	Max.	Mean	Min.	No. individuals measured	Type
CORACOID					
Length	47.5	45.3	43.2	3	43.2
Breadth below furcular facet	6.0	5.3	5.2	3	5.3
HUMERUS					
Length	80.0	73.5	69.5	5	72.4
Breadth of proximal end	20.1	17.9	17.0		17.0
ULNA					
Length	31.7	30.0	28.3	12	29.5
Breadth proximal end	7.2	6.6	6.2		6.5
RADIUS					
Length	31.1	29.3	27.3	4	28.1
Greatest depth of shaft	6.1	5.6	5.4		
CARPOMETACARPUS					
Length	36.0	35.4	34.9	4	35.0
Depth proximal end through Ml	11.1	10.5	10.2		broken
FEMUR					
Length	56.5	55.4	54.7	3	54.7
Breadth of distal end	10.8	10.6	10.4		10.6
TIBIOTARSUS					
Length	....	83.9	....	1	83.9
Breadth distal end	9.5	9.2	9.0	4	9.4
TARSOMETATARSUS					
Length	42.0	39.2	37.3	3	...
Breadth of proximal end	10.9	10.3	9.9	?	10.2
SCAPULA					
Breadth proximal end	14.2	13.7	12.6	3	12.6

Table III

Measurements of M. diegense from
San Diego and Cedros Island + Laguna Hills
(figure in parentheses = number of specimens measured

Cedros Island (= M. cedrosensis) San Diego Laguna Hills

Coracoid

Coracoid Length max ~~Mean Min. Max Mean min max~~ mean min
~~(1)45.5. 51.7 (49.1~~ 45.0

~~max Mean min max mean min max mean min~~

	Cedros Island				San Diego				Laguna Hills			
	max		Mean	min.	max		Mean	min	max		mean	min
Coracoid Length		(1)	45.5		51.7	(8)	49.1	45.0				
Breadth below furcular facet		(1)	7.3		6.3	(9)	5.7	5.0				
Humerus Length	72.7	(2)		72.4	80.0 85.2?	(8(	75.5	71.0				
Breadth proximal end	20.3	(6)	18.6	17.0	20.3 26.7	(9)	18.7	18.2				
~~Breadth distal end~~	~~7.2~~	~~(2)~~		~~7.0~~								
Ulna Length to internal condyle	31.9	(10)	30.0	28.3	32.0	(4)	29.8	28.4	30.0	(5)	29.7	29.0
Breadth proximal cotylae	6.9	(10)	6.6	6.2	6.6	(5)	6.3	5.9	6.5	(4)	6.4	6.3
Carpometacarpus Length to distal end M 2	36.8	(4)	35.6	35.0	37.2	(6)	36.1	35.3				
Length process M I	16.0	(4)	15.6	15.0	15.4	(6)	15.2	15.0				
Depth M 1 to internal crest	11.1	(3)	10.5	10.2	11.5	(3)	11.3	9/8				
Femur Length gt.	55.4	(3)		54.5	55.6 (Type)	(2)		54.3				
Length intercond	52.8	(3)		52.1	53.6	(5)	52.7	51.5				
Tibiotarsus Length	~~83.9~~	(1)	83.9		98.7	(7)	88.7	81.0?				
Br. dist end	9.2	(2)	8.7		10.6	(1)	9.1	8.2?				
Tarsometatarsus Length	42.0	(3)	38.4	37.3	43.6	(3)	~~40.5~~ 39.6?	~~38.3~~ 37.0?	44.1	(2)		38.2
Prox. breadth	10.3	(5)	10.0	8.9	10.8	(3) (4)	10.1 9.7	~~9.8~~ 8.5	10.2	(2)		9.4
Radius Length	30.9	(3)	30.0	29.0	31.7	(3)	30.5	29.5				

Ratio %	15373	RHT 1284	M	~~previous~~ M
ulna/humerus	40	41	39.4	41
" coracoid	66		60.0	52
~~tarsus~~/femur		73.5	75	
carpus/humerus	49.5	49	48	
femur/ "	72	72	70	84
" tibia	62		59.5	
coracoid/humerus	63		65	81

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(in S.D. specimens) Although the distinct curve for most elements ~~each of the elements~~ shows a distinct mode toward the smaller end

Mode	
humerus	63 ✓
" ulna	25 ✓
" radius	?
" carpus	31 ✓
" femur	44 ✓
" Tibiotarsus	?
" Tarsus	?
" Coracoid	40 ✓

Meas. of Cedros elements are

Coracoid	45.5 in 1 specimen
Humerus	72.4 - 72.7, 6 spec 17-283
Ulna	28.7 - 32.5
Radius	29.0 - 31.1
Carpus	35.0 - 36.8
Femur	52.~~[illegible]~~ - ~~[illegible]~~ 53.0
Tibia	83.9 (1 spec)
Tarsus	37.3 - 42.0

The distinct curves for the coracoid, ~~humerus~~, ulna, carpometacarpus and femur all show a distinct mode for the smaller specimens. The larger bones being fewer in number are less clearly grouped ~~[illegible]~~ ~~Although the extremes are clearly~~ ~~Although the extremes of the two species is~~ ~~Although Each element of the two species, there and in~~ ~~readily distinguishable at the extremes,~~ ~~addition the distinct~~

In spite of the wide range in size in each element (from San Diego) and the distinct modes at the smaller end ~~in the ratio~~ of the distinct curves of most of the elements, some difficulty arises in determining the exact dividing line but ~~point of separation~~ for the two species; a deciding factor in determining the pt of separation has been comparison of the specimens from Cedros Id. It is clear that only one species is represented at that locality & it agrees in size with the larger of the two S.D. species. Consequently wherever several specimens of an element from Cedros Id provide a linear measurement This grouping has been used as a check in determining the range for the larger sp. from S.D.

278)392 14
278
1140
1112
8

392)2780
2744
4220

25.8)69.0 28
516
1740
4

97
28
69

690)2580 39.4
2070
5100
4830
2700

39 ~~0~~)387 9
273
100

397)3820 97
3573
2970
2959
210

30

Alcidae and —

	Humerus length	br prox	br dist	Ulna length	br prox	Carpus length inside to sympt	length M1	Femur ext length	br dist	Tibia length	br dist	Tarsus length	br dist	coracoid length	ht from per cora.	br Ster.	br pelvis at acet.	length pal max	br pre max
Uria Mür 480	83.3	16.3	8.5	63.5	8.0	44.0 ext 36.8	8.2	46.7	8.3	82.6	7.8	37.5	8.0	37.2	15.8	♂697 30.7	♯485 22.8		
max 674	91.7	17.5	9.0	69.0	8.5	(46.7 ext?) 39.2	7.8	50.3	8.1	90.7	8.2	40.5	8.0	40.0	16.5	♯485 32.8	♂507 24.4		
aver 6 7	87.7			66.4		44.6 ext		48.6		86.6		38.7		38.6 est		(39.7 1st costal proc.			
Cepphus 172	66.3	14.7	7.7	55.8	6.9	32.8	5.8	40.3	7.7	68.0	6.2	36.1	6.2	32.2	12.6	25.9	25.4		
Sunda 694	78.2	16.0	8.2	61.8	7.7	34.3	7.8	42.7	8.5	75.2	7.3	33.3	8.8	41.3	14.6	28.5		21.0	6.1
Great Auk	102.2?	25.5?		(60 aver. est?) 54.0	10.5?	(46.5 est. aver.) (45.5 ext length 39??	12.3	76.7	15.1	131?	14.2	50.3 53.7	15.2	(58.4 aver est?) 57.3?	22.0?	55	33?		
Galapagos Penguin	53.5	?	7.0	39.8	6.3	34.09 ext? 26.4		60.3	11.8?	80.0	11.4	26?	16.7	56	?	(42.5 to 1st cost. proc) 38.2	32.8		
Large Penguin	74.4	—		53.9		43.8		85.2		119.5	15.6	31.5?		76.7		52.5	49.3	✗	
Aver Gt Auk	105.7			est 60?		est. 46.5 ext length		74.2		132.1				est. 58.4		at 1st costal art. 64.8?			

Comparison Maucalla with Great Auk, Penguin & *Uria*

	Ratio humerus to coracoid	Ratio humerus to br. sternum	Ratio humerus to femur	Hum Actual length Humerus 83.5% 90	Fem. Actual length femur 90%	Ratio femur to tibiotarsus	Tib actual length tibiotarsus	Ulna actual length ulna [illegible]	carp. actual length (ext.) carpometacarpus 83%	cora Actual length cora-	Ratio carpus to ulna 82%	Ratio ulna to humerus	Br. sternum at 1st costal art.
SD Maucalla aver.	133.0	186.8	117.0	62.5 66.5–56.5	53.4 50.4–55.7	69	79.8 74.6 (92.8) 76.9	80 25.8 24.1–28.3 or (33.0)	32.3 29.9–35.1	46.8 42.4–52.2	125 or 118	43.5 or 41.3	38.7
TYPE & other large				78.5 est			92.8		39.5 est.			42.3 est	
Uria small	224	271	178.0	83.3	46.7	56.5	82.6	63.5	44.0	37.2	69.7	76.3	
Uria large	229	282	182.5	91.7	50.3	55.4	90.7	69.9	46.9	46.0	68.0	75.3	39.7
Great Auk	178.0	186.0	133.2	102.2	76.7	58.6	131.0	59.0	45.5	57.3	77.2	57.6	
G. Penguin	94.0	140.0	88.8	53.5	60.3	75.2	80.0	39.8	31.0	56.0	77.9	74.4	
Large "	96.9	151.0	87.3	74.4	85.2	71.4	119.0	53.9	43.8	76.7	81.6	73.7	

A Assoc'd with flightlessness

① Humerus smaller relative to coracoid

② Ulna gets smaller

③ Carpus gets smaller

④ Femur gets larger rel. to tibiotarsus

⑤ Coracoid gets larger

		NO good		✓	✓		✓	✓				
1	G.P 94	G.P 140	L.P 87.3	G.P 53.5	U 46–50	U 55–56	Mauc ① 76.9	Mauc 25.8 ①	G.P 31.0	U 37–40	U 68–69	M 43.5 41.3
2	L.P 96.9	L.P 151	G.P 88.8	② Mauc 62.5	Mauc 53.4 ②	Auk 58.6	G.P 80	G.P. 39.8	Mauc ② 32.3	Mauc 46 ②	Auk 77.2	Auk 57.6
③	M. 133	Auk 186	M ③ 117	L.P. 74.4	G.P 60.3	Mauc ③ 69	U 82–90	L.P 53.9	M. Newf 39.5	G.P 56	G.P 77.9	L.P 73.7
4	Auk 178	M ④ 186.8	Auk 133.2	④ M Type 78.5?	Auk 76.7	L.P. 71	M. Large 92.8	Auk 59.0	L.P 43.8	Auk 57.3	L.P. 81.6	G.P 74.4
5	Uria 224–9	U 271–282	U 178–182	U 83–91 Auk 102	L.P. 85.2	G.P. 75.0	L.P 119 Auk 141	U 63–69	U (44–47 Auk 45)	L.P. 76.7	M 118–125	U 75–76

	Hum	Ulna	Carp
G. Auk	102.2	59	45.5
U	83.3	63.5	44.0
M.	62.5	25.8	32.3
G.P.	53.5	39.8	31.0

Femur	Tib	Ratio femur to Tib
76.7	131	58.6%
46.7	82.6	56%
53.4	77.4	69%
60.3	80.0	71%

Great Auk

	Tibia length		Ulna length	Hum. length	Fem. length	Ulna	carp. length	Tarsus	Sternum br. 1st proc.	Sternum br. in front 5th proc.	Sternum br. at lat. proc.
Miller	122.0		55.7	111.7	75.8	56.7 ~~55.7~~	40.7	50.3			
	125.2		56.0	102.7	76.1	56.0	44.1	53.8			
Lam	131.0		59.0	102.2	76.7	58.2 ~~57.3~~	45.5	54.0	63.0	58.2	55.0
Lucas meas.	122.2 min (132.18M) 143 max										
	5) 643.4		170.7	316.6	228.6	169.0	130.3	158.1			
	128.6		56.9	105.5	76.2	56.3	43.4	52.7			

126.1
3) 378.2

3) 170.9
57.0

122 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 4

Proportions of shaft of tarsometatarsus in some auks (not mancallid)

✓ = corrected

	breadth	depth	ratio			gr. length	ext length / Length from artic surface back of tubercle	Br prox	Br at base of hypotarsus	Br across ridges of hypotarsus	✓ Depth prox end int'lly thru hypotarsus	Br across troch 3 & 4 / Depth mid trochlea	Ratio to br shaft / Br Distal trochlea (at shaft)	Ratio to Br. at scar / Least Br. sh	gr depth ext side shaft	gr depth int side shaft	Ht int troch above distal end mid troch	Ratio to prox br / Br sh at scar (dist edge)
Cedros Is. fossil	2.7	2.0	74.0		65151/15374	42.0	38.9/41.6	10.3	6.8	7.2	8.9 ✓	9.6/6.8	—	75.6%/5.6	4.95	3.8	—	72.7%/7.5
Cerorhinca	3.7	2.8	75.7		65144/15422	37.3	37.6/37.0	10.1	6.9?	7.1?	—	6.8/6.0	181%/8.7	76.3/4.8	3.8	3.0	11.5	62.3%/6.3
Fratercula	3.9	2.8	71.8	Cedros Id	65148/15418	—	—	—	—	—	—	6.15	—	5.3	4.5	3.3?	10.9	
Lunda	4.6	3.2	69.6		64153/15402	—	—	—	5.6	5.75	7.5	—	—	4.4	4.3	3.25	—	
All Corona del Mar separate large sp.					65151/15376	—	—	10.9	7.1	7.3	8.3 ✓	—	—	—	—	—	—	71.5/7.8
All Cedros large					65151/15375	—	—	—	—	—	—	—	—	4.7	4.5	3.7	—	
All Laguna Mancalla large					65151/15388	—	—	9.9	6.6	6.8?	—	—	—	—	—	—	—	
Mancalla tarsi that are					1067/2455	dist end						5.7/5.1	7.4	4.4	4.0?	—	9.9	—
good enuf to assign					UCMP 45852	—	—	10.7	6.6	6.75?	—	—	—	5.15	eroded		—	
2178 M. large definite					1071/2178	43.6	40.6/43.1	10.8	7.2	7.4	8.0 ✓	7.8?/6.6	184%/9.8?	75.7%/5.3	5.0+	3.8	12.3	65.6/7.0
2327 M small				San Diego X	1075/2327	36.0	33.8/35.7	8.1?	5.85	6.0	6.55 ✓	5.3	183%/7.9	80.9/4.45	3.8	2.8	9.7	68.7/5.5
2499 M large ? (2 specs.					?/2499	37.0	eroded 37.0	eroded 8.6?	5.75	5.9	—	5.4 eroded	—	67.4/4.2	4.0	eroded 3.1	eroded 10.5?	6.2
2548 M small					?/2499	shaft only		—	—	—	—	—	—	4.7	4.2	2.9	—	
2327 M, small					1075/6454	35.8	eroded 35.6	—	eroded	5.9	—	eroded 4.9	168% eroded 7.2	76.3/4.5	eroded 3.7	3.0	eroded 9.4	5.9
2448 M, large ?				X	2482	31.1	31.0	—	5.1	5.2	6.15	5.6?/5.0	187%/7.3	82.5/3.9	3.5	2.7	9.1	4.7
2224 M large ?				X	2548	32.5	32.5	broken 8.3	5.6	5.7	6.6	5.7/5.1?	167%/7.2?	81.3/4.35	eroded ? 3.5	3.0	9.4	5.35
2682 M small					2232	—	—	9.4	5.9	6.1	7.1	—	—	—	—	—		64.8/6.1
2232 M small?				Corona del Mar	2250	—	38.2/—	10.0	6.4	6.4	7.6 ✓	—	179%/8.6	72.6/4.8	eroded ? 4.2	3.5	—	66%/6.6
					1067/2035?	—	—	—	—	—	—	—	—	74.1/4.55		3.2	—	6.15
					1067/2034	shaft only								74.3/4.6				6.2

Ratio	Cedros RHT1284	S.D. large M	SD small mean	Cedros 15373
Tarsus to femur	69.7% same ind.	81.4 (max)	78.4 (mean 79.0 (max 73.0 (mins.)	
" to tibia	15373 + RHT1284 45.8	47.3 same indiv? ~~[illegible]~~ 44.6 using max	46 (using means) 46.4 (maxs 43.1 (mins.)	45.8?
femur to tibia	65.3 (same indiv)	60 (means 60.4 (max 62.4 (mins.	63.5 (means) 64.4 (maxs) 62.5 (mins.)	
				68.5%
ulna to coracoid		62.3	65.3	75.6
femur to humerus		max large & [illegible] 65.9 min 73.4	59.5	59.6
coracoid "		65.3	63.3	
carpus "		46.8	50.3	49.5

Uria ↓ 1947 work Ratios in %

at Br. Stern. [illegible]	Sternum at 1st costal	coracoid length	Humerus length	ulna length at inter. ext. side	carpometacarpus length (ext)	femur length	tibio length	tarsus length	Pelvis Br. at act.
Uria 477 35.6	38.6	38.6	86.3	63.2	—	48.5	86.2	39.5	22.0
485 36.3	39.7	38.4	86.7	62.5	43.4	47.6	83.6	36.9	22.8
494 35.8	40.7	40.3	90.5	67.5	45.6	49.7	89.4	39.0	23.1
674 35.0	37.8	40.5	91.4	67.0	46.4	50.2	91.1	40.4	23.0
480 34.6	36.2	37.7	83.2	61.2	44.0	47.3	82.5	37.5	24.1
507 35.0	38.0	39.6	89.2	65.0	44.5	49.8	89.2	39.3	24.1
697 34.6	37.1	39.0	86.5	63.7	43.2	47.0	85.4	39.0	23.8
248.3	268.1	274.1	613.8	450.1	267.1	340.1	607.4	271.6	163.5
35.4	38.3	39.1	87.6	64.3	44.5	48.6	86.8	38.8	23.3
Galapagos Penguin 42.0	~~42.5~~	~~56.0~~	~~53.5~~	~~39.8~~	31.0	60.3	80.0	26.0	32.8
	42.7	56.3	52.2	39.8	31.0	59.2	81.6	25.0	32.3
Mancalla 36.6	38.7	48.7	56.8	23.3	29.8	50.4	72.8	43.7	33.5
36.0	38.0	51.7	64.7	24.4	31.7	54.2	74.5	38.3	30.8
			68.0	31.6	35.2	56.3	91.4		
				23.9		47.3			
							80.8		
							78.3		
72.6	76.7	100.4	179.5	103.2	96.7	208.2	397.8	82.0	64.3
36.3	38.3	50.2	59.8	25.8	32.2	52.0	79.5	41.0	32.1
Gr. Auk avg	60.?	56.3	105.5	56.9	43.4	76.2	126.1	52.7	?
mt'd bird → 58.2	63.0	58.2	102.2	59.0	45.5	76.7	131.0	54.0	33.0

	sternum	coracoid ?	humerus	ulna	carpus	femur	tibia	tarsus	pelvis
avers. Manc to Uria	100%	128.0	68.4	40.1	72.3	107	91.5	105.5	138.0
converted to sternum = 100%	100%	128.1	68.4	40.1	72.3	107	91.5	105.5	138.0
cora as 100%		~~100~~	~~52.7~~	~~31.3~~	~~56.3~~	~~83.6~~			
Auk to Uria	156.5	144	119.2	88.5	97.5	157.0	145.2	136	141
converted to sternum = 100%	100	92	75.5	55.9	62.3	100	92.8	86.1	
		100	82.7	38.0	43.2	109			
Penguin to Uria	111	143.1	59.5	62	70	122	94.0	64.5	140
converted to sternum = 100%	100	128.1	53.2	55.8	63.0	~~118~~	84.6	58.1 60.3	126.0
Auk mt. to Uria	164.0	149.0	116.8	92.3	104.4	157.9	151.0	139.0	141.3
cora = 100 Manc		100	52.6	31.2	56.4	83.6	94.5	82.5	
auk		100	82.9	61.5	47.4	109	100.9	94.5	
Penguin		100	42.5	43.3	48.7	85.9	64.4	46.8	

Manc, cora larger than ulna by 45% +
Uria " smaller " " " 45%
Penguin " larger " " " 25%
Auks " + ulna same length

Mancalla

Cedros Island

Nov 1965

30.7 / 15369

	Ulna gr. length	length top int cot to int cond.	Depth prox end	Br. prox cotylar	Depth ext cond.	Below foramen Depth sh mid	Br sh mid	
15354, 15371 RHT 1270 R unit B x	31.3 -	30.7	10.3	7.0	8.1	6.5	3.9	⑦
15429 R RHT 1285 unit 6 x	30.6	30.0	—	6.55	7.1	6.2	3.8	⑤
45157 RHT 1323 15364 units 6-8	—	—	—	—	7.0	6.2	4.1	
65148 R 15415 Cedros 4 Unit F x	29.8	29.5	9.2?	6.5?	7.5	6.6	4.2	③
65148 L 15414 Cedros 4 Unit F ✓	31.9	31.2	9.7?	7.2	7.8	6.9	4.2	⑨
65148 R 15412 Cedros 4 Unit F x	28.7	28.5	8.9	6.4	6.4	5.8	3.9	① min
65151 Cedros 2 unit L	—	—	—	—	7.5	5.9	3.7	
65153 L 15398 RHT 1312 Unit L	32.5	31.6	10.0	6.7	7.1	6.2	4.2	⑪
65153 R 15395 RHT 1312 Unit L ✓	31.8 -	31.0	—	6.7	7.55	6.4	4.1	⑧
65153 R 15394 RHT 1312 Unit L x	30.9 -	30.3	—	6.6	7.1	6.6	4.0	⑥
65153 15399 RHT 1312 Unit L ✓	30.4	29.5	9.8?	—	7.2	6.5?	3.8?	④
65153 R 15397 RHT 1312 unit L x	29.2	28.6	10.1	6.2	7.5	6.7	4.2	②
65153 juv RHT 1312 R Unit L	—	—	—	—	6.9	—	—	
65149 R 15372 Cedros 7 unit M	32.3	31.8	9.9	6.9	7.1	6.1	4.1	⑩
Cedros 15373 x	M 30.2 29.7	29.5	9.5	6.5	7.3	6.2	4.2	addn 5.8.69
max	32.5	31.8	10.3	7.2	8.1	6.9	4.2	
aver.		30.2	9.7					
min	28.7	28.5	8.9	6.2	6.4	5.8	3.7	
S. D. max aver min	30.8 25.3	29.6 22.2	9.3 7.4	6.8 4.9	—	6.8 4.6	3.8 2.9	
Laguna Hills max	30.6	27.1	9.3	6.6	—	6.3	4.2	
aver., min.	29.7	23.3	7.7	5.4	—	4.9	3.2	

[illegible] other

	Tarsometa gr. length to mid troch	int length	Br prox	Br mid sh	Depth prox (int.)	Br. hypo tars
R RHT 1297 Unit 6	37.4	34.6	10.1	4.8	—	6.3
RHT 1296 Unit 12	—	—	10.1	—	—	6.4
Cedros 2 R Unit L	42.0	38.9	10.4	5.6	8.7	7.1
Cedros 2 prox Unit L	—	—	10.0	—	8.4	7.0
sh Cedros 2 Unit L	—	—	—	4.8	—	—
juv RHT 1312 Unit L	—	—	9.0?	4.5	7.3	5.6
prox RHT 1304-1272 Unit L	—	—	9.4	—	—	6.4

	Humerus Br prox	cap grow
Cedros 8 Unit L	19.8	
→	17.6	
→ L	20.3	
→ R	16.9	
1287 1291	18.4	3.3
	16.6	2.4

Cedros Island Mancalla specimens

RHT 1297 = LACM 65144
15425

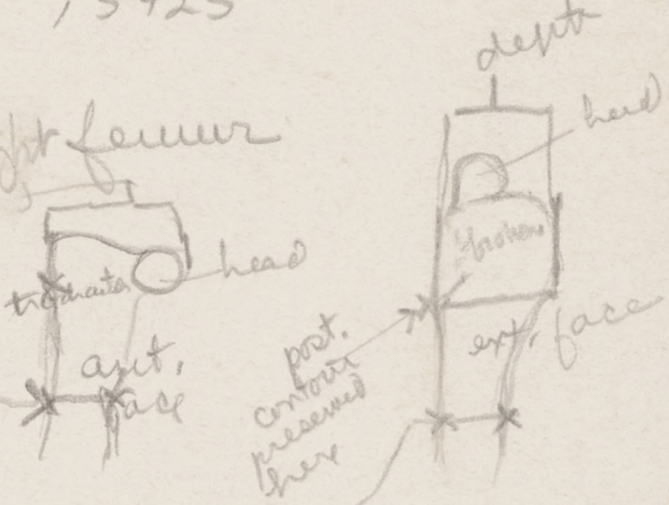
Proximal end right femur

Br 9.8

Depth 8.7

Brdth 5.0 below troch. ant'ly ridge

Depth th 5.55 below troch ridge (ext.)



fragments of shaft of tibiotarsus

16 vertebrae (fragmentary)

scraps of pelvis & ribs

Length of centrum of vertebras		Br. ant	Br. Post
① 8.5	(through center)	5.2	6.1
④ 9.4		4.6	—
⑤ 8.7		4.6	—
⑥ 7.6		5.0	
② 8.8		5.0	6.3
10.6		4.6	—
③ 9.2		4.9	5.3

Cedros Id, Mancalla specimens

RHT 1284 = #23739 (loc. 45144)

crushed pelvis, 2 femora (R + L), 1 tarsus (L)
distal end tibia (L)

Tarsometatarsus

Length 38.4 (middle trochlea to intercotylar tubercle)
bone is mended + a little offset - might make slight difference in length

Br prox end (max) 10.1

Depth mid. troch 5.6; Lg. mid troch 3.4; Br mid + ext troch. 6.9

Br 3 dist. troch. 9.1 (Shaft held parallel to calipers)

Ht of troch (int) above dist edge of int. side of middle troch 4.2

Br. sh 5.0, gr. depth sh ext 4.0

Tibiotarsus

Post br tibia dist 7.9

Ant Br tibia (dist) 9.2

Depth " (ext) " 8.65

" " int " 9.05

ratio tarsus/femur 73%

Femora ~~Left was~~ attached to pelvis
Rt was separate

	Rt.	Left
Length head to int. cond.	54.4	53.7
" troch to ext. condyle	55.5	55.0
" artic to inter cond. space	52.9	52.1
gr Br across dist. condyles (ant.)	10.9	10.0
Br across ext + int. " (not fib.)	8.5	8.5
gr depth dist (ext.) but bar of calipers against ant. edge of all condyles	10.0	10.0
Dept. int. condyle	7.7	7.6
Br prox troch to head	10.1	10.3
Depth prox through trochanter	8.6 (may be slightly exag. because of repair)	9.5 may be exag. by repair
Post. br. troch below head	6.8	4.8
Br. sh middle	4.6	4.6
Depth " same place	5.5	5.5
Depth head	5.1	5.1

Loc. No. 65148
Cedros 4 (Unit F.)
Arroyo Delphin

Mancalla

15414-15 Right & left ulnae

15416 Radius

15417 Left tibiotarsus (2 fragments, a shaft & a distal end)

15418 Right tarsometatarsus (in 3 fragments)

15419 Scapula (fragment

X Sacrum ? (in matrix)

Small alcid

15420 Right humerus (proximal fragment)

15421 Left coracoid (upper end)

~~Albatross~~ Palaelodidae

15422 Fragment distal end tibiotarsus

~~Goose~~ ? Palaelodidae
15423 ~~[illegible]~~ Distal end left tarsometatarsus

Species ?

. Pedal phalanx

one

Other fragments to be prepared before identifying

Loc 65148 RHT 1327 Unit F

Cedros Id.

15413 Sulidae – distal part humerus

15407 small tarsus (alcid ?)

15408 humerus (alcid)

15406 ulna "

3 phals unidentified (3 sizes)

RHT 1317 Cedros I

15403 ulna Puffinus

15404 dist humerus Puffinus

Cedros Id. Mancalla skeleton

#1296 = LACM 15373

Right Humerus gr. length 73.3; br. condyles 7.2
*Length to condyles 72.4; br. prox 17.9
~~Ht~~ to ~~tip~~ ectepicond. process 15.9

Right ulna ⓐ ~~ext~~* length to olecranon 29.7*
b Palmar length to intercotylar ridge & int. cond. 29.5
c Br. cotylae (prox) 6.5; d Depth prox 9.5
e Depth ext. dist. 7.3, Depth x Br. mid. sh. 6.2 x 4.2

Left Ulna a, 29.3; b, 29.1, c 9.4 d, 6.4; e 7.45

Left Radius * gr. length 26.0; least length 26.6

Left carpometacarpus ext length 35.8

Right femur ext length 54.6; int. length 52.8
Br. prox at greatest protub, ~~ext~~. 10.5; depth prox ext 9.2
; gr. br. dist, 10.6

Left femur, gr prox br. 10.2; depth prox ext. 9.5

Right tibiotarsus, length to artic. 83.9
Br. dist 9.4; depth int. 8.8, ext 8.7

Left Tibiotars
Br. dist, 9.4 dept. int, 8.6 ext 8.5

Right Coracoid, gr. length (int. ÷) 45.5
*Length back of int. tips *43.2; dist. prox from below scap. fact 15.6
Br. func. fact 7.3, ht func. fact ant'ly 5.3

Scapula, br. artic 12.6, br. neck 6.4

5.1.67

				S.D 1949
Ratio ulnar/*humerus length			40+ %	41 %
" carpo./ulna	"	—	121+ %	122
" femur/*humerus	"	—	~~72+~~ %	84 %
" " /tibiotarsus	"	—	64+ %	
" tibio/*humerus	"	—	115 %	
" *radius/*ulna	"	—	94+ %	
" *coracoid/humerus*	"	—	169 59+ %	~~8~~1 %
" ulna/coracoid	"	—	68 %	52.6

56
~~58~~7
6~~9~~10
6~~8~~0
66
4)256 3 ~~64~~
64

233
244
316
3)793
264

50.4
54.2
56.3
3)160.9
53.6

29.8
31.7
35.2
3)96.7
32.2

Mancalla from Cedros Id.

Coracoid ✓ 15373, ✓ 15400 (inc)

Ulna ✓ 15272, ✓ 15373, ✓ 15424, ✓ 15374 Pos 65152, ✓ 15412
✓ 15414, ✓ 15374, ✓ 15418, ✓ 15371, 15377 (dist)
✓ 15398

Radius 154✓

Carpometacarpus, ✓ 15391, ✓ 5373, ✓ 15392
Tarsometatarsus ✓ 15374, ✓ 15305 (shaft) ✓ 15418 (dist)
✓ 15402 (prox 5/8)

Humeri
65145/15367 ✓
65153/15388 ✓, 15389 ✓
65157/15382 ✓
65147/15373 ✓ (unnumbered)

Jacketed RHT 1310 = 65150/15410
✓✓ 2 incomplete coracoids
✓✓ 2 " scapulae
✓ 1 furcula
✓ 1 crushed sternum

Ret'd 11.13.68
Ulna ~~65152/15384~~ ok above

Oct. 16 – Borrowed
Mancalla from San Diego
A Small form to be described

~~Humerus~~ 2813
Coracoid 2229
Carpometa. 2068
Femur 2135

B Other
Ulnae 2082, 2497 (2), 2439, 2552 ~~[illegible]~~
6426
[2064, 2248, 2322 – larger]

Humeri
7731
2610
2219
2480 ~~[illegible]~~.
2096

Radii 2484 ~~large~~, 2812 large

Coracoid 2422 large, 2855 small
2310, 2371 (size?

Carpometacarpus 2542, 2341
2060 + 2355 (all large)

Tarsometatarsi
small: 2682 small, 2548 small, 2327 large, 2488 small, 6454 large?, 2455 small dist.
large: 2178

Mancalla from Corona del Mar
~~Humerus~~ (prox 2576) (dist. 2517)
Coracoid 2581
Ulna 2580
Carpo. 2558, 2483, 2033
Radius 2879
Tarsus (shaft 2034, 2035) complete 2250

✓ = took home Oct 30, 1968

RHT = R. H. Tedford field II

Lists of Cedros ~~& Laguna Hills~~ localities & material (Cedros details too)

Cedros Island Mancalla

see below

unit 6 RHT 1297 & 1283 &
Locality 65144 (RHT 1284) Blocks in jackets

No. (RHT 1284) 223739 — R and L femora measured 56.2 & 55.65 mm (52.8 intercondylar) — Dist. end L tibiotarsus br. dist 9.2 — Complete L tarsometatarsus (mended) 38.3 — jacketed - 1 indiv.

Jacketed prepared by HH — Referred

No. 15425 (RHT 1297)
Prox. half L femur
Prox. and frag. shaft L tibiotarsus
Complete R tarsometatarsus 37.3 mm
Distal end tibiotarsus
— jacketed - 1 indiv. verts & frag pelvis

Jacketed prepared by HH — Referred

No. 15427 (RHT 1283) ✓
Tarsometatarsus in matrix
No. 15424 ✓ Ulna

arroyo Espuelator

Locality 65145 (RHT 1287 and 1291)
No. 15367 ✓ Complete humerus unit 10 72.2 mm
No. 15368 Prox. end humerus " 10
No. 15369 Complete radius - 27.4? (larger? probably 28.4 as 15373 listed with it at 28.1 & " is now listed as 29.1)
No. 15370 Incomplete carpometacarpus

Locality 65146 (RHT 1288) unit 12
No. 15365 Dist. end R femur
No. 15366 Prox. tip L carpometacarpus

unit ~~12~~
Locality 65147 ((RHT 1296) jacketed block - 1 indiv. Top of unit 12
No. 15373 ✓✓✓ R and L ulnae 29.5 and 29.8 length
✓R ✓ Humerus complete 72.1 mm length
✓ ✓ R coracoid complete 45.5
✓ ✓ L carpometacarpus nearly comp. (& frag. of another)
✓✓ R and L femora 54.6 complete one (52.1 intercondylar)
✓R Nearly complete tibiotarsus 83.8 ~~[illegible]~~ (br. 8.7 dist.)
Distal half tibiotarsus
✓L Radius and frag. of another 29.0 mm
Frag. prox. end tarsometatarsus

Jacket prepared by Joe Koch at Mus. TYPE

15416 larger than 15373 (radius)
15374 much larger than 1284
1284 slightly larger than 15323
15425 smaller than 1284

65148
Locality 16548 field no.?
No. 15412 ✓ Ulnae also prox. tip humerus?
No. 15414 ✓ Ulna
No. 15415 ✓ Ulna scapula 15419
No. 15416 ✓ Radius 31.1 mm
No. 15418 ✓ Incomplete dist. half tarsometatarsus
No. 15417 Shaft and dist. end tibiotarsus

arroyo Delphin

Locality 16549 ~~[illegible]~~ [Cedros 7, Jefferson]
No. 15372 ✓ Ulna Cedros '7' Unit M

Locality 65151 (1292 & 1304)
No. 15374 ✓ Tarsometatarsus complete 42.0 mm length
No. 15375 ✓ Shaft of tarsometatarsus
No. 15377 ✓ Distal 3/4 ulna
No. 15382 ✓ Prox. end humerus (also a distal frag.)
Nos. 15378 and 15379 Dist. tibiotarsi (78 ident?)
No.? and vertebrae (2)

arroyo Tiberon

15383 - humerus (frags)
15376 tarsus (prox)
15380 frag humerus
15384 " carpus
15385 prox radius
~~[illegible]~~, 15370 - tibiot?,

Locality 65152 units 6-8 (RHT 1323)
No. 15364 Distal 3/4 ulna

unit M diseased 35.0 of length

Locality 65150 (RHT 1310) jacketed - 1 indiv. Unit M
No. 15410 Complete carpometacarpus, 2 ~~lower~~ ~~upper ends~~ R & L (complete) coracoids, ~~1~~ 2 R & L scapulae and a sternum crushed in matrix; furcula in matrix (HH still has May 18, 1969)

Check museum

Jacket prepared by HH — Referred

(wasn't in jacket block that HH prepared at home)

Locality 65153 (RHT, 1312)
No. 15388 ✓Humerus prox. and shaft (2 pcs.)
No. 15389 ✓Prox. humerus (2)
No. 15391 ✓Carpometacarpus L
No. 15392 ✓Carpometacarpus R
No. 15393 Radius 30.9
No. 15394 ✓Ulna
2 ✓15398,&99 Ulnae
No. 15400 ✓Incomplete coracoid RHT 1323 2 unit 6-8
No. 15401 Scapula
No. 15390 Beak
No. 15397 Dist. end ulna 15409 tibia shaft
2 No. 15395,&96 Ulnae
No. 15408 Prox. humerus
No. 15402 ✓Tarsometatarsus (prox.)

Locality 65154 RHT 1270
No. 15371 ✓Ulna

Tentative list of bird bones from Cedros Island, presented by
Dick Tedford for the University of California, Riverside

Mancalla:
- Unit B -- 1 ulna
- Unit F -- 3 ulnae, 1 frag. humerus, 1 distal end tarsometatarsus, 1 frag. of scapula, 1 distal end of tibiotarsus, 1 radius, 1 sacrum (?) in concretion
- Unit 6 -- 1 ulna, + tarsometatarsus
  2 blocks with incomplete skeleton (2 blocks?, 1283? 1284?, 1297) ✓ ✓
- Units 6-8 -- 1 ulna
- 52 Unit 10 -- 2 humeri, 1 radius, 1 carpometacarpus
- Unit 12 -- 1 distal end of femur, 1 frag. carpometacarpus, 1 block with incomplete skeleton 1296 ✓
- Unit L -- 6 humeri (mostly proximal ends), 1 coracoid, 1 scapula, 7 ulnae, 5 tarsometatarsi, 1 rostrum, 3 carpometacarpi, 1 radius, 3 incomplete tibiotarsi, X
- Unit M -- 1 ulna; ~~1 block with incomplete skeleton (1296)~~

Miscellaneous species unidentified
- 18 Unit F -- 1 large distal end tibiotarsus (size OK for albatross or flamingo) 65148/15422
  1 distal end humerus (sulid) (20.4 [illegible]) < S. humeralis = 19.8) 65148/15420
  2 small auklet bones (humerus and coracoid) Cerorhinca or Lunda or Fratercula 65148/15421
  1 very large pedal phalanx
  1 ?sulid? pedal phalanx
- Unit 6 -- 1 frag. of cranium (auklet?) 65144/15426 Loc. 65157 / 15386-15387)
- Unit L -- 2 ulnae 65153/15404, 1 humerus 65153/15403 (Puffinus?), 2 tarsometatarsi Puffinus
  1 humerus 65153/15405, 1 ulna 65153/15406, 1 tarsometatarsus 65153/15407 (auklet?) Cerorhinca, Lunda or Fratercula
  1 frag. ulna, sp.?
  1 frag. humerus, sp.? (~~small grebe~~? Endomychura? ~~[illegible]~~ dist end ulna alcid Cerorhinca?
  3 pedal phalanges (3 spp.) loc. 65153 unnumbered (1 large, 1 med, 1 tiny)
  loc. 65151 (not L) ? (1 block with ~~cormorant~~?) (1336 Base of Unit L)

1 large distal end tarsometatarsus, large ~~[illegible]~~, Palaeodus 65148/15423

~~Coracoid, humeri, ulnae & cranium are closer to Brachyramphus than~~ to ~~Endomychura, Ptychoramphus or Synthliboramphus~~

Tarsus too heavy for any [illegible].

Mancalla	52
~~Puffin~~ (alcid)	8
Shearwater	4
Large sp. try Megapal.	2
Sula	1
Sandpiper?	~~5~~

May 1969
Compiled from notes made previous

Cedros Island Mancalla

72 bones

1296-65147
15373
one indiv.

R.coracoid
R.humerus
R.ulna
L.ulna
L.radius
L.carpometa.
R.femur ✓
Lfemur ✓
R.tibia
L.tibia
frag.tarsus
frag.R rad.

12 ✓

1312-65153

L.cora 15400 x
scap 15401 x
hum.P. 15408 x
hum.P 15388 x
ulna 15395 ✓
ulna 15396 x
ulna 15397 x
ulna 15398 x
ulna 15399 x
radius 15393 x
hum.(2)15389 x
beak 15390 x
carpus 15392 x
carpus 15391 x
tarsus 15402 x
1 R ulna, 15394 x

1965 65151
Tedford 1272 & 1304
Whistler Cedros 2
1964

humP.D 15382 x
hum P 15383
fraghum 15380
fragcarpl 15384
tarsR 15374 x
tars.L 15375 x
tarsP 15376
tarsP 15385
tib.D 15378 x
tib.D 15379 x
ulna D 15377 x

11

1310-65150
15410
one indiv.

coracoid R
coracoid L
Furcula
Scapula R
Scapula L
sternum
carpom.

7

65148

ulna 15414 x
ulna 15412 x
ulna 15415 x
radius 15416 x
tarsus D 15418 x
tibia D 15417 x

6

53
9
11
72

1270-65154

ulna 15371

1323-65152

ulna- 15364 x

65149 x

ulna 15372

65146 and 1299 RHT
1288
(1299 RHT)

femur D 15365 x
carp.P 15366 x
(1288)

65145 RHT 1287 T 1291

humerus 15367 x
hum P 15368 x
Radius 15369 x
Capro. 15370 x

9

65144-1284
#1 23739

R &Lfemur ✓✓
Tibia D
✓tarsus

3

1297-65144
15425
one indiv.

femur P ✓
tibia P
frag.pelvis
verts
tibia D
R Tarsus

5

1283-65144
15427

tarsus
(in matrix)

15424 x
ulna

What are these nos.? 15380-81, dist hum, 65151 } Mancalla; vert "
15384-87 → L "; carpus inc R 65151; 85 prox L tarsus "; 84 L tarsus " } Mancalla; } Puffinus
15403-07, 15409, 15411, 15413 — Sulid 65148 humerus
15411 — R ulna 65148 Mancalla
15409 — Mancalla tibia sh 65153
15419-15423 — Scat 65148
20-23 2 alcid, 1 albatross, 1 Palaeochenoides, 1 goose, 20-21 Palaeochenoides, 1 reptile — all 65148

03-04 Puffinus
05-07 Alcidae

get # for RHT 1284

Include in Mancalla

15380-81
84-85
15409
15411
15419

Cedros Island Mancalla bones -- arranged by element

(jacketed bones have locality no. as well as cat. no.) TYPED in

SCAPULA
15410 (65150) - 2
15373 (65147) - 1
15401 1 (65152)
15419 1 65148

CORACOID
15410 (65150) - 2
15373 (65147) - R
15400 inc. 1 65153

have 15383 65151

HUMERUS
15373 (65150) - 1
15367 1 65145
15368 prox 1 "
15382 pr.& di. 2 65152
15388 pr.&sh 1 65153
15389 prox. 2 65153
15408 prox. 1 65153
15380 dist. 1 65151

ULNA
15373 (65147) - 2
15364 dist 1 65152
15371 1 65153
15372 1 65149
15377 dist. 1 65151
15394 1 65153
15395 dist 1 65153
15396 1 65153
15397 dist. 1 65153
15398 1 65153
15399 1 65153
15412 1 65148
15414 1 "
15415 1 "
15424 1 65144
15411 1 (humerus?)

RADIUS
15373 (65150) comp 2
15369 comp 1 65145
15393 comp 1 65153
15416 comp 1 65148

ROSTRUM
15390 1 65153

FEMUR
15373 (65147) - 2
15425 (65144) - 1 prox
23739 (65144) - 2
15365 dist. - R 65144

TIBIOTARSUS
15373 (65147) - 2
15425 (65144) - 2
23739 (65144) - 1 dist
15378 ident? 1 65151
15379 1 65151
15417 dist 1 65148
15409 shaft 1 65153

TARSOMETATARSUS
15373 pr.frag. - 1 (65147) Tarsus 15376 (65151)
15425 (65144) comp - 1
23739 (65144) comp - 1
15374 comp - 1 65151
15375 shaft - 1 "
15402 prox 1 65153
15418 dist 1 65148
15427 comp? 1 65144 (RHT 283)
15385 prox L 1 65154

CARPOMETACARPUS
15373 (65147) 2
15410 (65150 1
15366 prox 1 65146
15370 inc 1 65145
15391 left 1 65153
15392 r.comp 1 65153
15384 inc 1 65151

VERTEBRAE
15381 1 65151
15425 (65144) 16 (also scraps pelvic and ribs
23739 crushed pelvis [jacketed specimen LACM loc. 65144}
not 2 65151

FURCULA AND STERNUM
15410 (65150) one of each

Check for possibly associated
humeri 15367, 15368
radius 15369
carpometacarpus 15370
all from 65145

LIST of SPECIES from CEDROS ISLAND

5 Puffinus
  Ulna 65153/15404
  Distal end of humerus 65153/15404
  Two tarsometatarsi: 65151/ 15378 and 15386
  Distal half of tibiotarsus ????? # 65151 (15378) Alcid?

1 Sula?
  Humerus, distal end 65148/15413

5 Cerorhinca? new sp.
  Proximal half of ulna 65153/15406
  Proximal end humerus 65153/15408
  Proximal end of humerus 65148/15420
  Upper end coracoid 65148/15421
  Shaft of tarsometatarsus 65153/15407
  ~~Distal end ulna? 65148~~

3 Endomychura?
  Proximal end of humerus 65151/ unnumbered
  Distal end of ulna? 65151/ unnumbered → Cerorhinca (below & above)
  ? ~~Cranium 65144/15426~~

2 Large ~~goose???~~ Palaelodid
  Distal end of tarsometatarsus 65148/15423
  Distal end of tibiotarsus 65148/15422

SP.?
4 4 pedal phalanges
    one long 65148/unnumbered
    One large proximal end 65153/unnumbered
    one medium size 65153/unnumbered
    one tiny 65153/unnumbered

20

Mancalla cedroensis
  MANY

70

65148 — RHT 1327 — 15413 = Morus humerus unit F

65148 — RHT 1332 — Mancalla 15411–12

65145 — 1287 }
1291 } on same card Mancalla

65146 1299 Mancalla femur 15365

65151 Cedros 2 (unit L) Mancalla + Puffinus + hum 15376

65154 1270 Mancalla ~~hum~~ ulna 15371

65153, 1312 — Mancalla + Puffinus sp humerus 15404] +?
beak and others ulna 15403 #5

65153 Cedros 8 (unit L) Mancalla hum. 15408

65152 1323 Mancalla ulna 15364

65149 Cedros 7 " " 15372

65144 1297 jacketed Mancalla 15425

65147 1296 " " 15373

65144 1276 (unit 6) ~~Cerorhinca~~ alcid cranium 15426

65151 1304 }
1272 } on same card (unit L) Mancalla +
Cerorhinca ulna R&L distals
alcid dist humerus

65148 (Cedros 4?) Palaeoclades tarsus 15423 tibia 15422
+ Mancalla + probably Cerorhinca ~~hum~~ 15420 scap
hum 15421

65146 1288 Mancalla carpo 15366

65144 1285 (unit 6) Mancalla hum 15424

65144 1284 jacketed #23739 Mancalla

65144 1283 Mancalla tarsus in frags. 15427

65150 1310 Mancalla jacketed # 15410

TABLE II

Size Range and Variability in Length of Limb Elements of Mancalla from San Diego and Cedros Island

	Number of specimens	Length (in mm) Max.	Mean	Min.	Ratio of maximum to minimum	Coefficient of variability (V)
Coracoid						
San Diego	~~20~~ 16	54.0 ~~56.0~~	43.5 ~~44.6~~	38.5 or 34.2	140 ~~145~~%	11.~~7~~1
Cedros Island	2	45.0 or 47.5	[illegible]	43.4	104%	...
Scapula						
San Diego	~~19~~ 17	14.4	11.7	10.2	141	12.7
Cedros Island	~~12~~ 3	14.2	13.4	12.6	112	5.9 (5.9)
Humerus						
San Diego	30	85.2	65.9	56.4	151	10.2
Cedros Island	2	72.7		72.4	100	....
Ulna						
San Diego	19	32.0	26.4	23.~~8~~6	13~~8~~5	8.5
Cedros Island	12	31.8	30.0	28.5	111	4.4
Radius						
San Diego	8	31.8	27.1	24.0	13~~1~~2	10.4
Cedros Island	4	31.1	29.3	27.3	114	6.6
Carpometacarpus						
San Diego	12	37.1	33.6	29.7	125	7.1
Cedros Island	4	~~36.8~~ 36.0	~~36.1~~ 35.4	35.0	10~~3~~2	~~5.6~~ 1.4
Femur						
San Diego	15	53.6	47.~~8~~5	41.8 ~~42.6~~	12~~6~~8	8.5 ~~7.5~~
Cedros Island	2	53.0		52.1	101	...
Tibiotarsus						
San Deigo	16	98.~~7~~5	82.8	72.~~6~~5	13~~7~~3	11.0
Cedros Island	1		83.8			...
Tarsometatarsus						
San Diego	~~9~~ 8	43.6 7	36.6	31.1	140	11.4
Cedros Island	3	42.0	39.2	37.3	112	6.2

47.5
45.0
43.4
3)135.9
45.3

Mancalla ulna + radius Cedros study Nov. 4, 1970

~~Both~~ also the ulna ~~+ radius~~ of M. cedrosensis, has ~~have~~ better defined
intermuscular lines ~~[illegible]~~ in and is ~~[illegible]~~ generally
more rugose than in M. diegense. However, the poor
preservation of the S.D. specimens should not be overlooked.

One ulna ~~+ one radius of~~ M. milleri ~~are~~ is similar to M. cedrosensis
UCMP
45853
LACM ~~2432~~

~~Also closer to M. milleri is the extent of the line bordering the~~
~~longitudinal groove in the radius~~
~~The line bordering the longitudinal groove of the radius is rel.~~
~~larger in M. cedrosensis than in M. diegense + resembles~~
~~M. milleri in this respect.~~ ~~At the prox end of the radius~~
also ~~more~~ like milleri is the more rugose
~~the~~ area below the head of the radius ~~is more~~ externally.
This area is excavated in M. diegense.

In the radius the area immediately below the head externally
is raised and rugose ~~somewhat as in M. milleri~~ In M. diegense
~~there is an excavation between the head + the~~
~~the area is excavated immediately below the head before~~
The raised area is separated from the head by an excavation.
The cond in M. milleri more closely resembles cedrosensis

In The carpometacarpus the ~~in~~ternal crest of the carpal trochlea
is less rounded in posterior profile than in either S.D. species
~~and connect with M3 with is only slightly~~ and as seen
in internal view forms only a very slight notch
~~She~~ ~~curved~~ and the space bet the the crest + M3 (~~seen~~ int'ly is
only a broad shallow notch. In both M. diegense + M. milleri
the crest is rounded posteriorly + ~~forms~~ there is a clear break
~~at~~ between its distal termination + M3.

4, 969

Cedrus libani

1.6	998.56
1.6	998.52
2	973.44
0	960.00
.0	96000
30.2	912.04
300	900.00
29.7	882.09
29.5	870.25
29.5	870.25
28.3	800.89
28.3	800.89

12) 3619
30.1

10928.92
-10914.30
n-1 11) 14.62
1.33 = σ^2

$S = \sqrt{1.33} = 1.154$

$V = \frac{1.154 \times 100}{M} =$ 30.1) 115.4 (3.8
903
2510

Taurus.

37.3 1391.29
38.3 1468.89
42.0 1764.00
3) 117.6 4624.18
39.2 4609.92
n-1 2) 14.26
7.13 = σ^2

$2.67 = \sigma \frac{\times 100}{M} = V$

39.2) 267.0 (6.9
2352
3180

316
316
1896
316
948
998.56

31
31
31
93

312
312
624
312
936
97344

302
302
604
906
91204

297
297
2079
2673
594
88209

295
295
1475
2655
590
87025

283
283
849
2264
566
80089

361.9
361.9
32571
3619
21714
10857
130971.61

12) 130971.61
10914.30

263
263
789
1578
526
69169

2.65
2.65
1325
1590
530
7.0225

2.67
2.67
2269
1602
534
7.1289

108
1.08
864
108
1.1664

1.09
1.09
981
109
11881

1.1
1.1
11
11
121

1.15
1.15
575
115
115
1.3225

1.16
1.16
696
116
116
1.3456

1.155
1.155
5775
5775
1155
1155
1334025

373
373
1119
2611
1119
139129

383
383
1149
3084
1149
146689

42
42
84
168
1764

117.6
117.6
7056
8232
1176
1176
3) 1382976
460992

25
25
125
50
625

28
28
224
56
784

2.6
26
156
52
676

27
27
189
54
729
676
53

729
13
16